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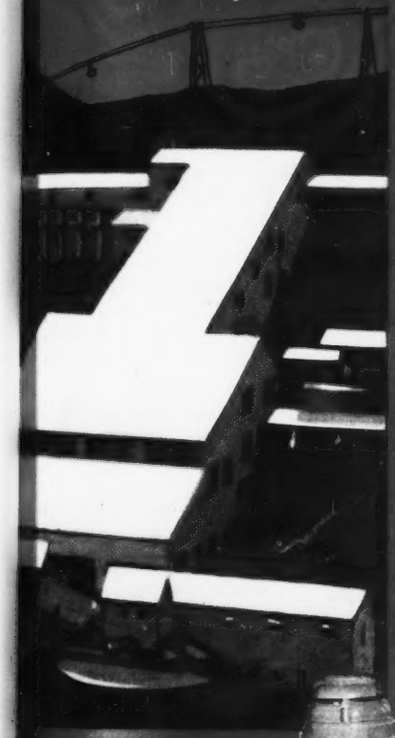

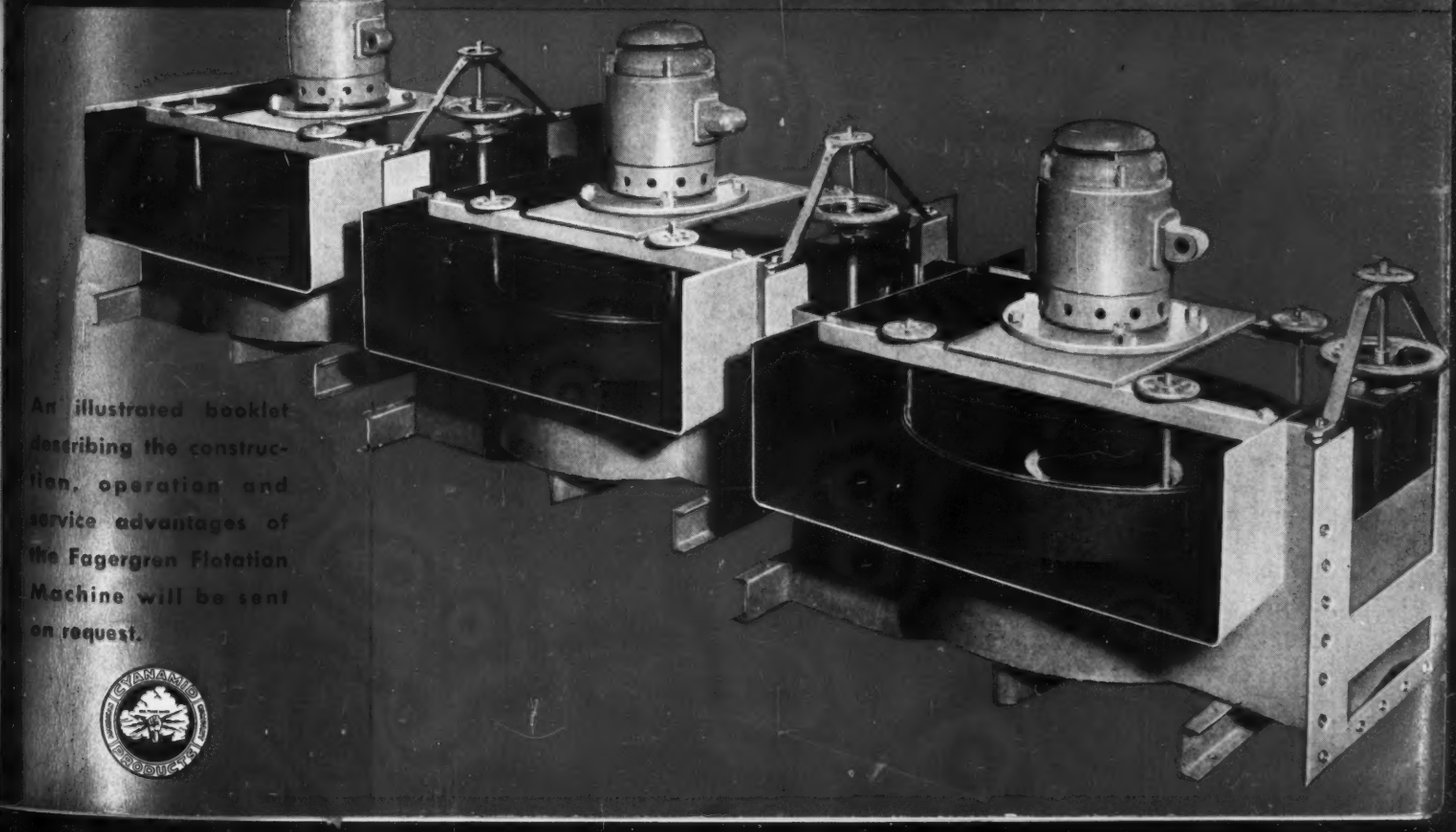

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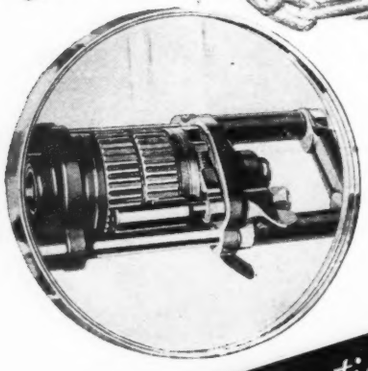

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H. C. PARMELEE *Editorial Director*

FEBRUARY, 1934

Complexities of The Copper Code

PROGRESS in approving the major non-ferrous metal codes apparently waits on the copper industry. Public hearings have long since been held on the lead and zinc codes, and they could probably be approved without much delay. The situation is different with copper. After months of tripping between New York and Washington, conferring, writing, and revising, vainly seeking compromises and offering new solutions, representatives of the respective elements concerned face the condition that agreement on a copper code is still marked by hope too long deferred.

Today's complexities of a single code for the copper industry are practically the same ones that loomed large months ago and led to the submission of several codes. Two major groups—the primary producers and the custom smelters—have divergent economic purposes to be served, inherent in the nature of their respective industries. In the public interest neither of these groups can be denied its economic place in the industry. And yet a compromise must be reached. Nor can the rôle of secondary metal be ignored. Another knotty problem is control and allocation of production by the various units of the industry, and a fair allocation of the market among them, whether or not they control fabricating outlets. Finally, the spectre of price determination raises its historic head, to the discomfiture of the industry and NRA alike.

Perhaps, considering the diverse interests of high- and low-cost producers, the large stocks of copper above ground, and the necessity for orderly marketing of current production, some temporary price agreement based on cost of production may be necessary to avoid complete chaos. But the history of nearly all recent attempts at fixing the price of commodities regardless of their supply and demand is a record of failure and disaster. No artificial device can possibly help the non-ferrous metal industries comparable to the benefits that would flow from general industrial revival.

In Washington a sympathetic and patient NRA is fully aware of the difficulties of the copper industry, and has shown no disposition to impose an arbitrary code. The impression prevails, nevertheless, that unnecessarily long delays have ensued in arriving at a basis for self-regulation of this industry.

The Spirit of Inquiry Vs. Contented Ignorance

ON THE COVER of the notebook in which a rising young metallurgist records the data of his experiments is sketched a large question mark—a challenge to the unknown, typifying the spirit of scientific investigation. It marks the contrast between the attitude of the researchers in his ore-dressing laboratory and that of many technicians—teachers and millmen alike—engaged in flotation work, who appear willing to let the why and wherefore of flotation phenomena remain for them mysterious. Some day the matter will be clearer, they seem to reason; in the meantime they pursue their work, with machine, reagents and procedure perhaps suggested by someone else—possibly a salesman; and if difficulties arise, they fumble "empirically" and at times stumble on the answer.

The majority of these individuals are no doubt technically trained. Why, then, do they balk at the less easily solved problems that come up in their flotation work? One may answer this question Yankee fashion by asking a few others. How can anyone without knowledge of the elementary principles of colloidal chemistry and organic chemistry understand flotation, which is a colloidal-chemical process pure and simple and involves to an important extent organic reactions? How can a man work intelligently with frothers and collectors, when he is almost wholly ignorant of their nature? Already the number of organic compounds which have been tested for flotation effect, and for which the record is available, is six or seven hundred, if not more. The structural formulas of many of them are formidable. Yet their behavior in flotation depends upon their structure. To pursue his work intelligently, the flotation engineer must be familiar with some two dozen major classes of such compounds, a well-known authority asserts. But in all too many cases the engineer has failed to supplement his limited knowledge of inorganic chemistry, received at school, by studying colloidal and organic chemistry. Perhaps it is no exaggeration to say that to him these terms have a terrifying sound. Colloidal chemistry may connote physiological processes with which he is totally unfamiliar. The organic field bristles with queer shapes, horrible names, and formulas in convulsions, or so it appears. Defective training is responsible for the engineer's difficulty. The remedy is evident. Flotation phenomena are chemical, and the chemistry is both organic and inorganic. The flotation engineer had better "bone up" on chemistry.

To acquire the necessary knowledge is less difficult than it seems. The engineer or mill man need not become a chemical expert, but he must learn the nomenclature of organic chemistry and must familiarize himself with the structural formula in place of the molecular, and in a general way become acquainted with the chemistry of carbon compounds. He must learn at least that the chemistry of surfaces, colloidal chemistry, is something different from the chemistry of solutions as he learned it at school. Again quoting the authority referred to, he must do at least this, if he is to work intelligently with flotation.

The Arts and Wider Application Of Technical Ability

IN THE months immediately ahead, when the period of adverse economic conditions from which we are emerging may be viewed in clearer retrospect, the increased interest in the arts and other cultural pursuits that adversity and enforced leisure occasioned will probably stand out as one of the few beneficent effects of the depression. The development lends credence to the belief that deliberate provision for leisure would encourage a continuation of this movement toward a higher level of intellectual quality. Incidentally, support for such a conclusion is apparent in the results published recently of a survey and analysis of the services that the public libraries of the country were called upon to provide during the last three years of depression and uncertainty.

This growth in cultural interests, however, has by no means been confined to the general mass of the population. In the last few years many business men, scientists, and members of the various professions have displayed a similar desire to experience the enjoyment that such avocations afford. An art exhibit, for instance, is held annually by the Business Men's Art Club of New York; physicians and surgeons from all sections of the country hold a similar exhibition each year, that of last year being held under the auspices of the New York Physicians' Art Club; and a very creditable "Exhibition of Art Objects Made by Engineers," in which the mining engineers were well represented, was sponsored by the American Society of Mechanical Engineers on the occasion of a recent annual meeting of that organization.

One of the most satisfying aspects of this broader interest in the arts is found in the valuable contributions traceable to just such endeavor. Probably no better indication of the aid that the technician may bring to art has been given than that which Dr. Colin G. Fink gave in the course of an address, "Chemistry and Art," presented recently at a joint meeting of the Society of Chemical Industry, American Chemical Society, the Electrochemical Society, and the Société de Chemie Industrielle, when he was the recipient of the Perkin Medal for his inventions in the fields of metallurgy and electrochemistry. Dr. Fink, whose achievements in restoring ancient bronzes by electrolytic methods have been described in *Engineering and Mining Journal,* referred in his address to the lack of understanding concerning the relationship of chemistry and art, and pointed out that few artists are conversant with even the first principles of chemistry and physics, and that even fewer chemists have interested themselves in the basic requirements of the artist. Effort of a character similar to that of Dr. Fink's is finding expression in a New York suburb, where a mining engineer, with a self-taught knowledge of music and musical instruments, has organized an 80-piece civic orchestra that is attracting wide attention, besides performing an important social function. This endeavor on the part of a technician in the field of music has, as in the instance of Dr. Fink, resulted in the contribution of new knowledge, taking the form of a heretofore unavailable technical analysis of sound and music.

In short, the evidence cited here would seem to lead to the conclusion that abundant opportunity exists in the arts for the application of technical ability. If such expression of that ability is the result of practicing an avocation, so much the better, for then not only will the pleasure of exercising technical skill be had but also that enjoyment which accrues to the devotee of the arts.

NRA Progress And Problems

EVEN a casual survey of the work of the National Recovery Administration shows astonishing progress toward its goal of establishing self-government for American industry under codes of fair competition. In the seven months since the National Industrial Recovery Act was signed by the President last June, more than 200 important codes have been approved, 360 have had public hearing, and about 500 remain to be heard. The record is the more remarkable when the NIRA is recognized, at least in Title I, not only as a measure for industrial recovery, but even more as an act for the reformation of business practices not in harmony with the general well-being. Apparently industry is slipping easily into code harness, enjoying the prospect of self-regulation and the abolition of nefarious trade practices, and finding the mandatory provisions of the law not unbearable.

With its major job of codification well under way, NRA has moved forward into the phase of compliance and enforcement. For chiselers and recalcitrants must be brought into line with the great majority of fair-minded and well-intentioned men who have accepted the provisions of the law, and who are entitled to protection from the minority that scorns the public interest. The law is not without teeth and NRA intends to make use of them. In Bulletin No. 7, modestly entitled "Manual for the Adjustment of Complaints," the whole machinery for compliance and enforcement is set forth, including recourse to legal action by the Federal Trade Commission and the Attorney General when conditions compel such a course.

Nevertheless, and despite the progress made, the codes still have kinks in them, as none knows better than NRA, and most of the important ones will be revised and changed in the light of experience. Questions of fundamental policy have yet to be decided. Price fixing has been, and still is, one of the major unsolved issues at NRA. Another is wages, with organized labor fighting doggedly for fixed scales for different types of labor in each industry, dissatisfied with minimum wages for unskilled workers only. The question of hours of work is another vital problem, on which General Johnson has voiced a widely held opinion to the effect that "eventually this whole country has got to go to a shorter work week." Finally, inter-industry conflicts are certain to arise to plague the NRA and business alike, as one industry seeks to protect its traditional markets against the inroads of competing products of another industry. Thus NRA has many phases of usefulness to which it may look forward. It will seek a solution of some of its problems in an experience meeting of code authorities that General Johnson has announced he will call in the near future.

Gold in the Lupa Field

Output as Yet Largely Alluvial—Vein Mining and Milling Lag

Frank Oates
Chemist and Petrologist
Geological Survey Department
Tanganyika Territory, British East Africa

THE Lupa gold field, discovered in 1922 by a prospector named William Cummings, is situated in the southwest corner of the British Mandated Territory of Tanganyika, within 30 miles of the administrative post of Mbeya. This small, scattered township forms one of the nightly halts on the Imperial Airways route, and passengers in the great airliners which ply weekly between London and Capetown cannot fail to remark the imposing escarpment beyond which, some distance to the north, lie the gold fields.

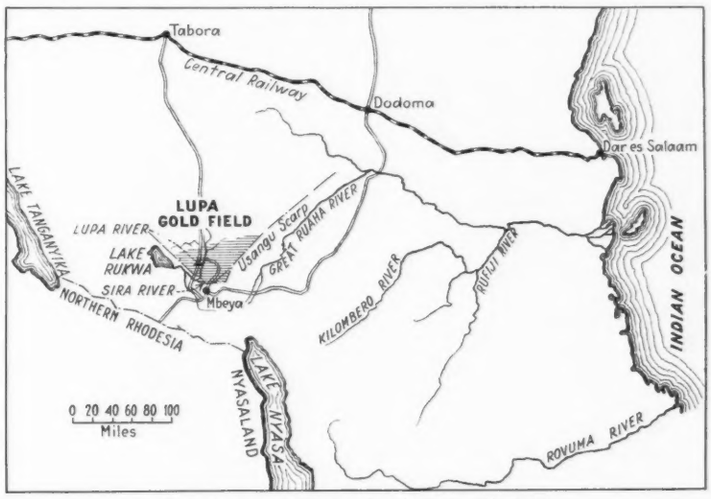
Although the Kakamega gold field in the neighboring British possession of Kenya Colony may perhaps have suffered from over-publicity, the same cannot be said of the Lupa; no complications existed regarding native rights in this originally almost uninhabited area to render it a matter of contention, to be wrangled over by politicians in the home country. The Tanganyika government, early assuming control, permitted the pegging and registration of alluvial claims, and the rich finds reported from time to time have been the means of attracting a polyglot floating population, among which all sorts and conditions are represented. The diggings offer an acceptable mode of life to many; it is a free and easy, hand-to-mouth existence, with its monotony flavored by the excitement of cleaning up a rich pocket once in a while. Those who before the gold boom of 1932 declared that the Lupa had been worked out were not familiar with actual conditions. The recrudescence of prospecting and alluvial working occasioned by the soaring price of gold demonstrated that instead of being worked out the field had not even attained its peak production.

Prospecting rights cost the individual 10s. per year, and an exclusive prospecting license can be had for £5 per year per square mile or part thereof. The royalty upon precious metals won amounts to 5 per cent of the gross sum realized. Other fees payable under the Mining Ordinance by lessees or claim holders cannot be regarded as excessive. In addition, a security not exceeding 2,000s. per capita is required by the immigration department.

Most European nationalities, and, of course, Asiatic Indians, are represented among the diggers. Those holding claims employ African laborers to wash the gravels by primitive methods of box-sluicing and panning at a daily wage of about 50c. (10c. or thereabouts in American currency) excluding *posho* (food usually consisting of maize flour and beans), which is provided in addition. Though nominally working under the direction of their employers, the "boys" are permitted a pretty free hand, and to estimate how much of the gold won is withheld from its rightful owners is impossible. A *prizi* or commission system is in force, it is true, whereby both laborer and gang headman earn rewards in proportion to the quantity of gold returned (20c. per pennyweight for the laborer who finds the gold, and 5c. per pennyweight for the headman), but, needless to say, some unprincipled person, black, brown, or white, is always at hand who offers or at least is willing to pay a higher *prizi*.

A large proportion of the labor on the Lupa is being recruited from among natives of Nyasaland and even Southern Rhodesia, the former being doubtless attracted by the higher rate of pay. Owing to this fact, kiswahili, as a *lingua franca*, is being largely superseded on the diggings by English.

Geology of the area is exceedingly complicated and has been made the subject of special study by the government geological survey. Both topographical and geological maps have been made, and the geology has been described in official publications.[1] The working area is tending towards extension in an east-northeast direction, and during the present field season a geologist and a topographer have been mapping the new region. The geomorphological aspect is of particular interest as showing how Nature has burst the door of the treasure house and revealed the wealth within: had the ancient peneplain remained undisturbed by tectonic influences the gold might have remained undiscovered.

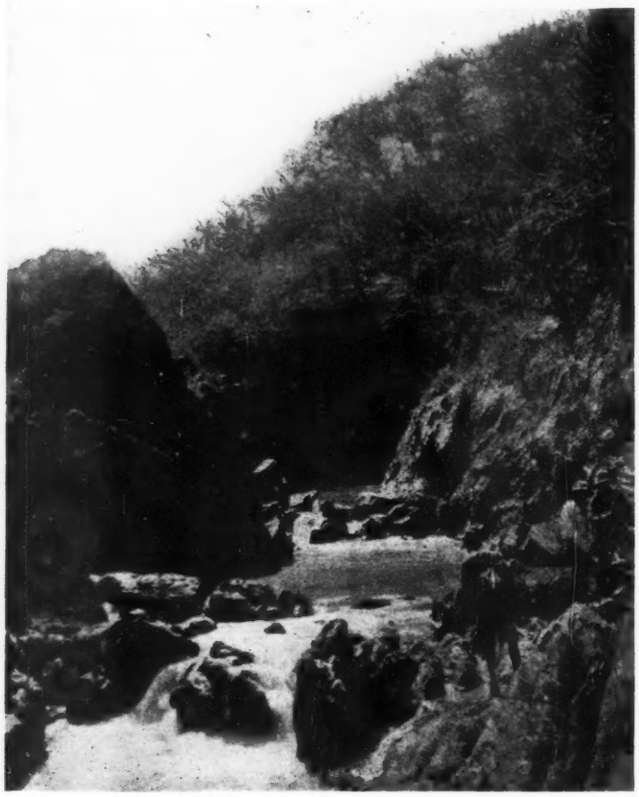


Sketch map showing the Lupa gold field

Briefly, one may say that the gold field proper comprises a triangular block of country upwards of 1,000 square miles in extent, with its southern apex and east and west sides sharply defined by the towering Usangu escarpment on the east and by the less lofty Rukwa escarpment on the west. The northwest apex is marked by the Ilunga Range, whereas towards the northeast the limits of the field are vague and undefined by physiographical features. This small fragment of the great Central African Plateau clearly constitutes a tilt-block inclined towards the southwest and in all probability squeezed up

[1] "The Lupa Goldfield," Bulletin No. 3, 1932 (two maps) and "The Eastern Extension of the Lupa Goldfield," Short Paper No. 11, 1933, both by D. R. Grantham, Government Printer, Dar es Salaam.

relatively to the surrounding country by powerful earth movements. The escarpments referred to are step-faults forming part of the extensive system of fractures that constitute a section of the Great Rift Valley, and are thus comparatively young geologically. Upon the rejuvenated tilt-block numerous streams



Cascades along the Lupa River where much alluvial gold is being recovered

are making a determined onslaught. The most centrally situated with reference to the northwesterly trending gold belt, as well as largest, is the Lupa River, whose headwaters commence quietly among the inselbergs of the peneplain country to the northeast. Reaching the rejuvenated area, the Lupa River thereafter descends swiftly by falls and cataracts through its boulder-strewn, deeply incised and incredibly rocky channel, to plunge over the escarpment on its way to join the northwesterly flowing Sira River. United they pursue a meandering course along the base of the scarp, gathering on their way the waters of many smaller streams, the courses of which, following lines of shear or faulting, have run more or less parallel with the course of the Lupa. The combined waters discharge into the Songwe River and thence into Lake Rukwa.

The Sira is a permanent river and consequently does not afford the alluvial workers the same advantages as does the Lupa, which at the height of the dry season displays a bare, rocky channel with here and there residual pools. Boulders of granite, diorite, dolerite, schist, ironstone, iron-stained quartz, and other kinds of rock bestrew the beds and banks of the Lupa and of other similarly rejuvenated streams, their large size and well-rounded nature testifying to the force of the storm waters.

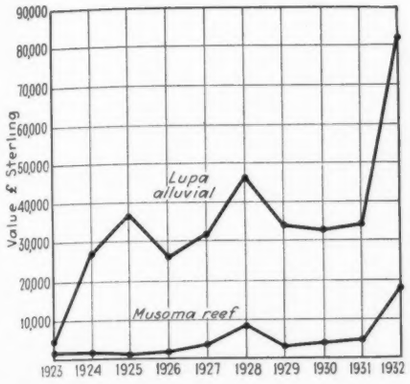
Favorite resting places of the precious metal are on either side of transverse rock bars, in potholes, and in cracks and clefts of the rocky river bed. The coarse gold penetrates deep down into the cavities and is best cleaned up by chipping away the top layer of bedrock and opening up cracks and fissures therein by crowbars; it is extraordinarily erratic in its distribution. The usual procedure adopted by the alluvial digger is to work when the river is at its lowest, draining likely looking pools by damming, and breaching and pumping operations, so that they may be well and truly cleaned up.

In spite of a considerable amount of seasonal redistribution of gold in the existing channels, an increasing tendency prevails on the part of the diggers to forsake these for the terraces that mark the courses of the streams in earlier phases.

With the onset of the rains the population disperses, and many go to the plateau areas above the headwaters of the streams, there to seek eluvial and alluvial gold while water is available. In a few of the plateau areas, washing can be carried on all the year round; in others, less favored, the existence of coarse gold constitutes a powerful inducement to many who stay on throughout the dry season, during which they win the gold by methods of dry concentration. This type of gold differs from that of the river gravels in its greater angularity and coarseness; it has been shed from decaying reefs and concentrated by erosional lowering of the land surface without having been subjected to the effects of appreciable lateral movement. It is found, often at grass roots, in the flats of the raised and geologically ancient topography that has escaped rejuvenation, and it is won by grubbing and rooting about at shallow depths beneath the surface soil. No machine is used; the pay dirt, or what is hoped is such, must be perfectly dry before attempting concentration. Human lungs do the rest. It is broken up and roughly pulverized by the "boys" who enact the part of bellows, and who, by continual blowing, winnow the clayey dust from the slugs and shotty gold.

Geological study of the field does little to help the alluvial diggers and dry-blowing fraternity, save in a general way, as the gold continues perversely to appear in the most unexpected places, whereas likely looking spots have a habit of drawing a complete blank. Experience has shown, however, that the most favorable areas for heavy gold have usually been in the vicinity of geological contacts hereafter to be referred to. Eluvial gold in these areas is uncommonly coarse; nuggets ranging from a pennyweight to an ounce are quite common, and larger ones up to 100 oz. or thereabouts have occasionally been found. As might be expected, plenty of gold-bearing reefs exist all over the Lupa area, and in connection with these, in particular, the work of the Geological Survey has proved of value. The metallogenetic zone has been shown to be of considerable vertical extent, and the auriferous veins are found pretty constantly around the marginal portions of the younger granites, which are marked by basic differentiates and hybrids having the general characters of granodiorite. Contacts of granite and diorite, and granite and more ancient rocks, such as the banded ironstone series, have proved especially favorable. The younger granites have a characteristic pale green and pink appearance and display little or no foliation—features that enable them to be readily recognized by prospectors.

Of the reefs, a few are being somewhat inefficiently exploited by small syndicates, whereas others are being laboriously developed by tenacious farsighted individuals who believe that their turn must come when the big companies elect to step in, and meanwhile are content to bide their time, sitting dourly on their reefs and carrying on with as much exploratory work as their attenuated capital permits. The vast majority of the reefs, however, are



Graphical record of gold production from Lupa alluvials and the Musoma reef

unproved, unpegged and—one may even say—undiscovered. They are of all sizes from small leaders a few inches in width to big "blows" of quartz forming noticeable topographic features. Some of those which I have seen, and known to carry good values, ran up to six feet in width, whereas the larger ones have not as a rule proved so promising as regards their average value. The prevalent lenticular form accounts for much disappointing "cutting out," though "making," a little to one side and further along, is always on the cards, as the lenses seem to favour an *en echelon* arrangement in a common shear zone. Values are irregular as a general rule, the gold occurring typically in shoots. Costeaning at frequent intervals is necessary to prove continuity, and a considerable amount of development is imperative to determine whether or not a given reef is payable.

An encouraging feature of the field is the occurrence of great quantities of superficial quartz rubble commonly averaging up to 4 dwt. to the ton and therefore worth milling while gold remains at its present price.

In the uppermost portions of the reefs the gold is free-milling, but its fine state of division and enclosure in pyrite at quite inconsiderable depth necessitate fine grinding and cyanidation at an early stage in mining operations. This, no doubt, is the result of steadily maintained recent erosion which has kept pace with the oxidation of the sulphides. The auriferous quartz is usually well laminated but varies widely in appearance. The gold contains from 10 to 20 per cent of silver and among other minerals occurring in the reefs are chalcopyrite, covellite, galena, carbonates of lime and iron, tourmaline, and, less commonly, barite and graphite.

Bonanzas have been found but are not specially abundant: this fact, however, need not appear irreconcilable with the coarseness of the eluvial gold nor with the fact that, as stated, large nuggets have occasionally been unearthed. The wide vertical extent of mineralization considered in relation to the vast depth to which erosion has proceeded seems to provide an adequate explanation of this apparent inconsistency. One of the most famous of these "jewelers' shops," which averaged 8 per cent gold, was at the junction of a smallish reef with a greenstone dike. The inference is that such dikes might profitably be investigated along their strike to see if they intersect quartz veins.

Though semi-arid climatic conditions prevail, with an unbroken period of drought lasting from May to December, the rainy spells are torrential and the percentage run-off is high, permitting conservation of surface water in dams. The requisite sites for catchment, though common enough, should be narrowly examined before final selection, on account of the shattered nature of much of the bedrock. Shaft-sinking operations have demonstrated that water is usually struck below 100 ft., and on mines operating below this level it would probably be found advantageous to make use of this when unwatering, if only as an auxiliary supply. The country is lightly timbered—more heavily on the slopes of the hills—and the prevailing species afford a plentiful supply of reasonably straight poles suitable for mine timbering.

Before the gold boom, the Tanganyika government can hardly be said to have sponsored the cause of the gold-mining industry with any great enthusiasm, but a decided reversal of the former apathetic attitude is now in effect owing to the prominent place assumed by the precious metal among the exports of the country. A committee has been formed under the chairmanship of the general manager of the government railways with the express purpose of achieving useful liaison between those government departments best calculated to assist the gold-mining industry. Upon this committee are represented the heads of the following government departments: Railways, Public Works, Mines, Geological Survey, and Survey, and a program of topographical and geological mapping, road construction and maintenance, and improvement of road and rail communications has been initiated. The hope is that to this list of benefits will be added revision, favorable to the consignee, of the existing railway freight rates on mining machinery, so as to give a needed impetus to reef mining.

Favorable consideration is being accorded a proposal entailing the transfer of the administrative post to a situation more central with regard to the mining area. Consummation of such a plan, though devastating to vested interests in Mbeya, would undoubtedly prove the greatest boon to the mining community. Until recently no medical officer was actually available on the gold field itself to attend to the needs of some 500 Europeans, both male and female, and a much larger number of Asiatics and Africans, and even now no official appointment has been made, although a qualified German medical man has established a practice and does a certain amount of government work by arrangement.

If inhospitable, the country is not unhealthful; in the deep ravines of the rejuvenated rivers the heat is oppressive in the dry season, but nights are generally cool. The lowest altitude on the Lupa is over 3,500 ft. above sea level, and towards the northeast, whither the field is extending, the country rises to 7,000 ft. or more along the Usangu escarpment.

At present, Lupa Market, on the Lower Lupa, is a typical mining settlement, characterized by numerous tin-roofed shanties, Indian *dukas* (stores), grass huts, a tumble-down, thatched postoffice—and a complete absence of sanitation. A scene of considerable activity is presented, and, besides the work being done in the actual channel of the river, its banks and terraces are being energetically explored. Later on, the advent of the rains will see a more or less deserted Lupa Market, and tor-

Natives panning gold along the Lupa River near Lupa Market

rential downpours will wash away offense.

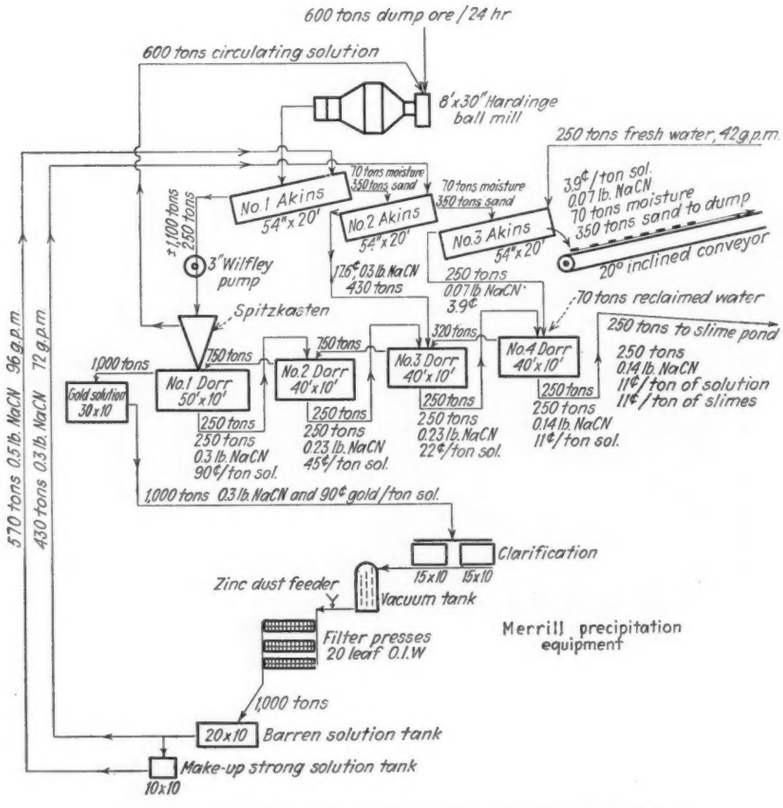
Though close to the Imperial Airways route (a letter is delivered in Lupa Market ten days after posting in London, and consignments of bullion are now sent to Europe by air), the field is remotely situated. It may be approached from the port of Dar es Salaam, via Dodoma, at 284 miles on the Central Railway, by an all-weather road some 465 miles in length, the last section of which will be completed by the end of this year. This owes its switchback nature to having perforce to keep to the watersheds and lower mountain spurs. The alternative route is from Dar es Salaam to Tabora, on the Central Railway (523 miles), thence by a road infinitely superior as regards gradients and only 285 miles in length, but usable during eight months of the year only. The second route is clearly to be preferred, and unless, and until, it is made practicable as an all-weather means of communication, the prospects of large-scale reef mining, otherwise extremely promising, are hardly likely to prove attractive of outside capital.

Practically all the gold is now being won by the alluvial workers, and the government should, of course, assist and encourage them by every means in its power to maintain, if not to exceed, present production. Most long-established gold fields, notwithstanding, owe their longevity to their reefs, and it is distinctly regrettable that, in spite of the fact that the probably optimum price of gold has now been realized, so little ore is as yet being milled. The position regarding this in another part of the territory, the Musoma region, east of Lake Victoria, is reversed; with but little distraction here in the shape of tempting alluvial, and with superior communications available, the attention of prospectors has been focussed almost entirely upon the reefs, with the result that many small syndicates are operating, producing perhaps a quarter of the gold output of the Lupa and contributing no less than one-eighth of the total gold output of the territory. It is a thousand pities that at this propitious moment a similar state of affairs has not been achieved on the Lupa.

Signs are now manifest that Tanganyika is slowly but steadily emerging from the slough of economic depression. The rapid restoration of a favorable trade balance following a year of rigid retrenchment should inspire confidence externally as well as internally—the most important developments on the Lupa are probably yet to take place.

Re-treating Tailings for Gold At Mercur

The Manning Countercurrent Plant


600 tons dump ore / 24 hr.
600 tons circulating solution
8'x30" Hardinge ball mill
250 tons fresh water, 42 g.p.m.
No.1 Akins 54"x20'
No.2 Akins 54"x20'
No.3 Akins 54"x20'
70 tons moisture 350 tons sand
3.9¢/ton sol. 0.07 lb. NaCN 70 tons moisture 350 tons sand to dump
20° inclined conveyor
±1,100 tons 250 tons
3" Wilfley pump
17.6¢ 0.3 lb. NaCN 430 tons
250 tons 0.07 lb. NaCN 3.9¢
70 tons reclaimed water
Spitzkasten
320 tons
250 tons to slime pond
250 tons 0.14 lb. NaCN 11¢/ton of solution 11¢/ton of slimes
1,000 tons
750 tons
Gold solution 30x10
No.1 Dorr 50'x10'
No.2 Dorr 40'x10'
No.3 Dorr 40'x10'
No.4 Dorr 40'x10'
250 tons 0.3 lb. NaCN 90¢/ton sol.
250 tons 0.23 lb. NaCN 45¢/ton sol.
250 tons 0.23 lb. NaCN 22¢/ton sol.
250 tons 0.14 lb. NaCN 11¢/ton sol.
570 tons 0.5 lb. NaCN 96 g.p.m.
430 tons 0.3 lb. NaCN 72 g.p.m.
1,000 tons 0.3 lb. NaCN and 90¢ gold/ton sol.
Clarification
15x10 15x10
Zinc dust feeder
Vacuum tank
Filter presses 20 leaf O.I.W
Merrill precipitation equipment
1,000 tons
20x10 Barren solution tank
Make-up strong solution tank
10x10

Flowsheet of 600-ton countercurrent decantation cyanide plant of Manning Gold Mines Company

GOLD'S improved price has stimulated a new cycle of activity at Manning, near the old camp of Mercur, Utah, where W. F. Snyder & Sons and former Congressman Samuel S. Arentz have erected a plant with a capacity of 600 tons a day, using a process of countercurrent decantation to treat 500,000 tons of tailings. Originally treated in the old amalgamation plants of Mercur, prior to the development of the cyanide process, the mill dumps were treated again about 1900. Values are estimated to range from $2 to $3 a ton in gold, with the lowest grade running considerably below these figures and the high-grade running considerably above.

Two trucks working eight hours a day, loaded by gasoline shovel, keep the plant supplied with tailings 24 hr. a day. Recoveries are averaging about 70 per cent of the gold. Costs are expected to be as low as 60c. a ton when the mill is operating at capacity. Recently, operations have been limited by drought, which reduced the flow from the spring on the property. The company is considering building a 4½-mile pipe line to assure a flow of 75 g.p.m. as compared to the present supply of 25 g.p.m.

The ore is fed into a Hardinge ball mill from the ore bins by a 16-in. conveyor belt, the ball mill being used as a mixer rather than a grinder, inasmuch as the tailings are fine enough in their natural state. A pound of cyanide is added per ton of water, and the solution, water, and ore are thoroughly mixed.

The mill discharges into four 54-in. by 20-ft. Akins classifiers, where the slimes and sands are washed, the sands being discharged to waste as tailing and the slimes into 50-ft. thickeners. The

slimes progress in one direction and the cyanide solution in the opposite. After the solution containing the gold is discharged from the slime tanks it runs into filter tanks. Merrill-Crowe precipitation is used.

W. J. Franklin is in charge of the operation. A total of fifteen men are employed. Julius C. Ingersoll, consulting engineer for the Snyder interests, designed the plant.

Stripping a Placer's Overburden

POWER SHOVELING and hydraulic stripping have long been considered the only satisfactory methods for removing overburden. The novel method employed by the Idaho Gold Dredging Company at its property in the Bitter Root Mountains near Warren, Idaho, therefore, is of interest to the mining industry as suggesting another.

As indicated in the accompanying illustrations, removal is accomplished by a Le Tourneau 12-yd. Carry-All scraper operated by a gasoline-driven tractor, which moves from fifteen to twenty loads per hour over a haul of from 300 to 400 ft., dumping the material on spoil banks. The yardage hauled is from 100 to 150 per hour and cuts as deep as 8 ft. are made. Material handled ranges from loam to disintegrated granite sand. Cost of removing the overburden in this manner is much lower than if it were passed through the dredge in conjunction with the gravel, according to company officials.

Employer-Employee Relations Under the Recovery Act

SECTION 7. (a), controversial labor clause of the National Industrial Recovery Act,[1] passed June 16, 1933, was the most active subject of argument and debate in the early days of code writing by American industry. In its provision for collective bargaining by employees, organized labor saw a new charter for future unionization of all workers covered by the Act; industry saw a threat to the continuance of other forms of employer-employee relationships that had proved satisfactory in the past. Impending conflicts were a menace to the recovery program, and the Administration found it necessary to issue clarifying interpretations.

Donald Richberg, general counsel of the NRA, made it plain that "the law is not intended to enthrone any national labor organization or to dissolve any local organization." On different occasions General Johnson made the following statements:

> This (law) can mean only one thing, which is that employees can choose anyone they desire to represent them, or they can choose to represent themselves.
>
> The obligation of employers is not to seek to interfere with the efforts of workers to organize or with their choice of representatives.
>
> Any man can choose to bargain individually or collectively, and the idea that a man can be compelled or even influenced to join a company union or any other union is absolutely negatived by the plain words of this statute.

Finally the President denied permission to incorporate in the codes the so-called "merit clause" as an interpretation of Section 7. (a), saying:

> While there is nothing in the provisions of Section 7. (a) to interfere with the bona fide exercise of the right of an employer to select, retain or advance employees on the basis of individual merit, Section 7. (a) does clearly prohibit the pretended exercise of this right by an employer simply as a device for compelling employees to refrain from exercising the rights of self-organization, designation of representatives, and collective bargaining, which are guaranteed to all employees in said Section 7. (a).

[1]Sec. 7. (a): "Every code of fair competition, agreement, and license approved, prescribed, or issued under this title shall contain the following conditions: (1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; (2) that no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and (3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President."

With the law thus interpreted and written into all codes, the question arises as to the effect that the labor clause has had on employer-employee relations since the passage of the Act. The only definite information available is contained in the results just published of a recent inquiry by the National Industrial Conference Board, New York.[2] Questionnaires were addressed to 10,335 industrial and mining companies selected from Thomas' Register, with a rating of AAA, $500,000, or higher. Replies were received from 3,314 companies employing an aggregate of 2,585,740 wage earners, or 27 per cent of the estimated total number of workers employed in manufacturing and mining. Breadth of coverage and a representative sample were thus obtained. Obviously, relatively few metal mines were included, but the general results are nevertheless of interest to mining companies as indicating the trend of individual and collective bargaining in American industry.

A condensed result of the survey reveals some striking facts. Of the workers covered by the inquiry 45.7 per cent deal with employers individually, 45.0 per cent through employee representation, and 9.3 per cent through organized labor unions. Employee representation plans have gained rapidly in number and popularity since the passage of the Recovery Act. Prior to June, 1933, such plans were in effect in only 223 of the companies surveyed. Since that date they have been introduced into 400 companies. Union agreements, on the other hand, were in effect in 232 companies prior to NIRA, and have since been adopted in 174. With respect to both number of companies and number of employees affected, employee representation has made greater progress since NIRA than have union agreements.

Employer-employee relations vary in type with the size of the company. Individual dealing prevails generally in smaller companies. The reverse is true of employee representation. Tabulation shows that, as the size of establishment increases, the proportion of companies dealing individually diminishes, while the proportion of companies using employee representation increases as the size of establishment increases. There is apparently no correlation between size of establishment and labor union agreements, although the greatest union strength is found in medium-size companies.

When the situation is viewed industry

[2]"Individual and Collective Bargaining Under the N.I.R.A." A statistical study of present practice. Nov., 1933.

by industry, a surprising preference is shown for individual dealing with employees. Among manufacturing industries only clothing and printing and publishing show less than a majority of concerns in which individual dealing prevails. In the chemical industry the proportion runs as high as 87.1 per cent. Employee representation is evenly distributed over the industrial groups. Organized labor shows its greatest strength in the coal and clothing industries.

Response to the Conference Board's inquiry was made by only 14 metal-mining companies, and inasmuch as the inquiry was directed only to those companies having a rating of AAA, $.00,-000, or higher, it may be assumed that these metal mining companies are among the largest and most important in the United States. Of the 14 that responded, the policy of individual bargaining prevails in 4, employee representation in 9, and union agreement in 1. The number of employees under these policies are, respectively, 3,374, 8,112, and 1,191. In round figures, 64 per cent of the metal-mining companies and employees covered by the inquiry are under employee representation plans. No other industrial group showed so large a proportion of companies under employee representation; and only one, rubber products, showed a larger proportion of employees under this plan of dealing with employers. The preference shown for individual bargaining and employee representation in metal mining is in marked contrast to conditions in the coal-mining industry, in which 83.6 per cent of the companies and 89.8 per cent of the employees deal with employers through organized labor unions.

The most striking result of the survey is the relatively small proportion of employees found to be dealing with employers through organized labor unions. Second is the indication of progress made by employee representation plans, particularly among large industrial companies where some form of collective bargaining is necessary. Third, if the survey had been extended to the large number of small companies in the country, it is likely that individual bargaining would have cut down somewhat the favorable showing for employee representation. It is evident, however, that individual bargaining has not been eliminated by Section 7. (a), in spite of the fact that employee representation seems to have gained the initial advantage over labor unions.

Block Signals

For Safe Transport Underground

Lucien Eaton

Consulting Engineer, Milton, Mass.

IN MINES where more than one locomotive is operating on the same track, some sort of block signal is necessary, and the need increases with the speed and weight of trains and density of traffic. The simplest form, and one often used in hand tramming, is a paddle or light, hung at the side of the drift when a train enters a one-end block and retrieved on leaving.

The next step is an electric light turned on by hand or by opening or closing a track switch. This is suitable for branches off the main lines, having only one entrance point. To be satisfactory a green light should be shown when the block is clear; otherwise a red light. The switch controlling the light, if hand-thrown, is actuated by a lever or by two bell cords. Sometimes it is thrown by the lever of the track switch or by the trolley wheel of the trolley locomotive. This is automatic and satisfactory, if kept in repair, but maintenance charges are higher than when lights are hand-operated. When the switch is operated by a lever hand, the latter can be arranged so that it is always moved in the direction of the train's motion. Difficulties are largely mechanical, as sturdy construction is needed. When bell cords are used, two are necessary, one cord for turning the red light on and the green light off, and the other for the reverse. The difficulty with the pull-cord switch is that the short cord is to be pulled, whereas the natural instinct is to pull the long one, because it is in a more convenient position. This trouble has been overcome by use of a drum switch which is operated by a ratchet and a single cord. This type of switch, however, is not on the market.

The next step is an arrangement whereby lights are thrown on at both ends of a block by a switch at either end. This can be done just as in a single-ended block, but requires a more elaborate switch or relays to throw the switches at both ends simultaneously.

Hand-Operated Lights

In their most advanced form, underground block signals are installed in the same way as on surface railway lines, the signals being actuated by electric current flowing from one rail to the other through the wheels of locomotive and cars. The rails are insulated from each other at the end of each block, and the ties provide sufficient insulation from the ground. Little trouble is caused by water on the track. The operating circuit is a.c., single phase, at 110 volts. The cycles are different from those in the regular power circuit, and, in a double-track line, are different for each track. Twenty-five and 40 cycles work satisfactorily without interfering with each other. The wiring is so complicated, however, that except on main lines where traffic is heavy and speeds are high, hand-operated lights are usually preferred. Even with the automatic system at work on the main track, hand-operated lights or those operated by the track switches are used on branches.

With this system, on leaving the shaft there is a short block (A) about 100 ft. long. The next block (B) and succeeding blocks may be from ¼ to ¾ mile long. If Block B is clear, the lights are green at both ends. But when the train enters Block A, the far light turns red in both Block A and Block B. As soon as the train enters Block B, the far end of Block C shows red, and both ends of Block B. If trains should enter opposite ends of Block B and Block C at exactly the same instant, the operators would not know that the block ahead of them was occupied until they approached the junction of the two blocks. At this point they would each find that a red light was against them, and thus danger of a collision would be obviated. Under all other circumstances the lights keep one block ahead of the one occupied clear at all times. The red lights go on if there is a break in the rail in any block, because the relays that operate the lights are set to show red, when the current fails.

At Morenci

A simple system of automatic block signals having only one chance of failure—namely, when two trains enter a block at the same instant—is in use at Morenci, Ariz. The arrangement is as follows: Parallel with the trolley wire and about 4 in. from it at the same elevation is hung another wire of 00 section, which operates the signal lights. The locomotive uses a pantograph trolley which has a long brass roller in place of a wheel. This roller comes in contact with both wires, and allows current to pass from the trolley wire to the signal wire and thence to the lights. When a locomotive enters a block, red lights are shown in that block. There are no green lights, but instead a number of red lights in parallel, so that, if one burns out, others will be working. This system could be extended to clear the next block ahead also, but would necessitate an extra circuit. Two trolley poles could be used instead of the pantograph trolley with the long roller.

Converter Innovations *At Anaconda*

Cover and Natural Gas Burner of New Design

E. A. Barnard

Assistant Superintendent of Smelting, Anaconda Reduction Works, Anaconda, Mont.

Covered converter storing molten copper. Gas burner in operation

THE necessity of keeping copper converters hot during periods of delay became apparent during the recent period of curtailed operations at the Anaconda smelter. Delays in waiting for the reverberatory furnace to produce sufficient matter for a charge for the large converters often lasted four or more hours. Unless the converters were kept hot, unsatisfactory operation resulted when the charge was blown.

Copper anodes were cast from the refining furnace every day. It was apparent that only one furnace would have to be operated if the copper could be stored in the converter during the oxidizing, poling, and casting period of refining. A burner using natural gas, the design of which is shown in Fig. 1, was inserted through the mouth of the converter. To exclude cold air, this mouth, which has a diameter of 8 ft., had to be partly covered. A sheet-iron cover first used proved unsatisfactory because of the large size of the opening and the great heat of the converter. An arched cover of firebrick and regular fireclay mortar, tried next, lasted only two or three days, when it fell to pieces on account of the great expansion and contraction resulting from the alternate heating and cooling as it was put on and taken off the converter. Jarring of the cover in handling it with the crane also tended to loosen the brick.

A more sturdy and satisfactory cover was finally obtained by placing bricks flat in a frame and cementing them together with molten converter copper, as shown in Fig. 2. This has proved satisfactory.

Preparatory to operation, converters are now heated from the cold state by gas burners. The burner is first placed in the converter mouth by the crane, the converter turned to a horizontal position, and the burner lighted. An initial gas pressure of 5 lb. is used; this is gradually increased to 35 lb. at the end of eight hours. Two more hours at 35 lb. will heat the converter to the point where it can be turned up, whereupon the cover is put on while the heating is continued. With the cover on, a gas pressure of 10-25 lb. is used, depending on the temperature of the converter and how tightly the cover fits. A small air pipe bypassing the main converter air line supplies air through the tuyeres to aid in the combustion of the gas inside the converter.

Arch-shaped brick covers with fireclay mortar were used for several years to cover the 50-in. charge openings in the center of the roof of the copper refining furnaces. These covers generally last about two months. Lately they have been replaced with flat covers of the type used on the converters, molten copper serving to cement the brick. The new covers last about six months.

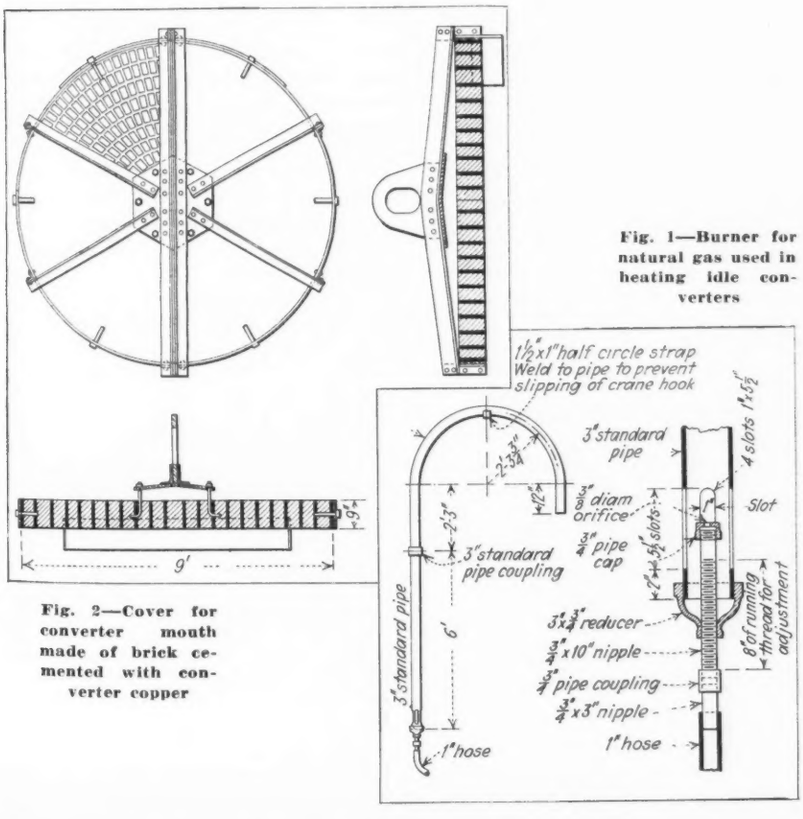


Fig. 1—Burner for natural gas used in heating idle converters

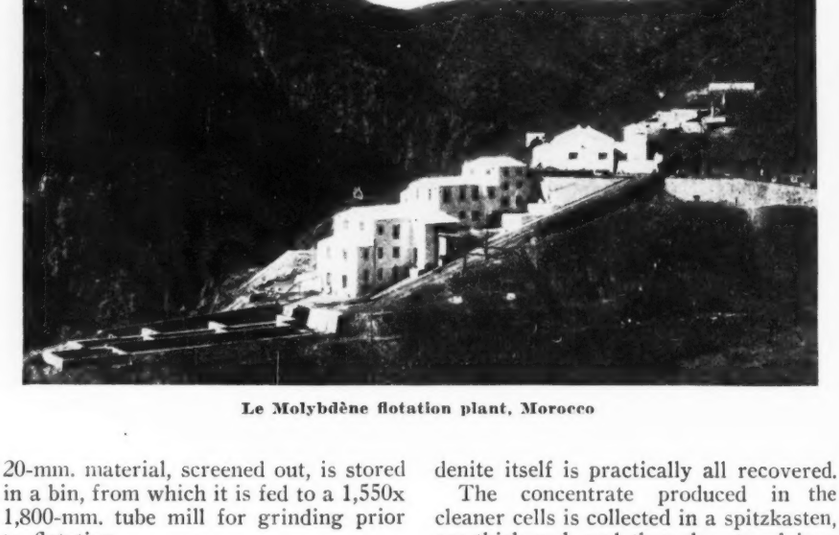
Fig. 2—Cover for converter mouth made of brick cemented with converter copper

Floating Molybdenite In Morocco

Copper Removed by Selective Process

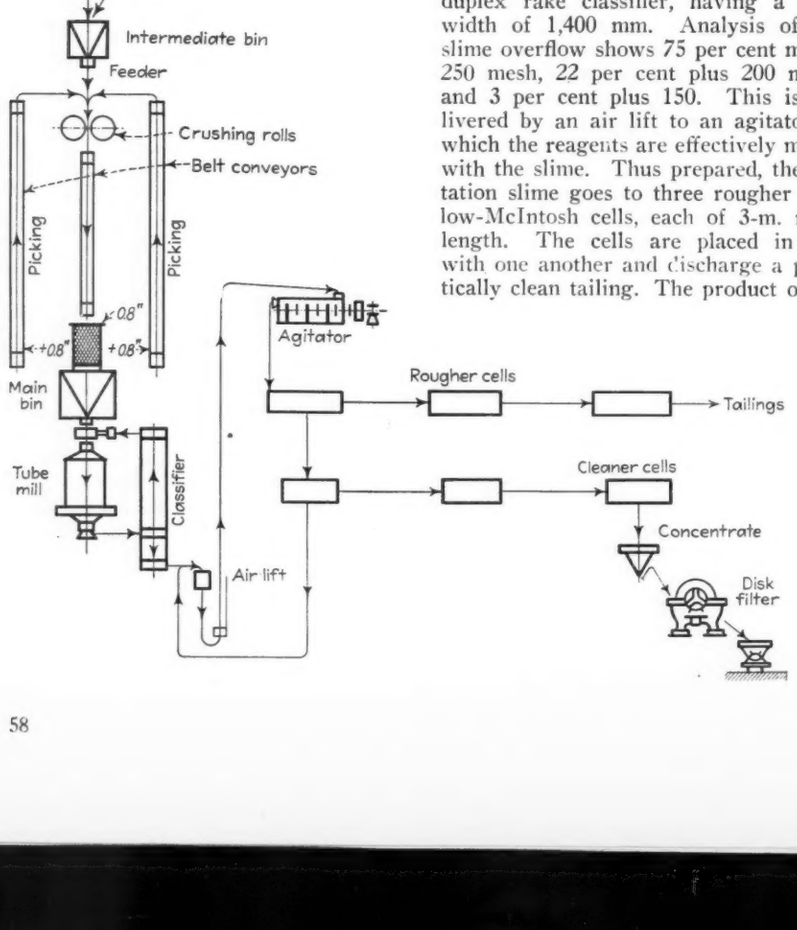
IN MOROCCO, in the district of Azegour, South Marrakesch, a molybdenite deposit is being worked by the French company Le Molybdène, of Paris. Operations to date indicate large reserves of ore. The deposit was discovered a few years ago. A flotation plant supplied by Krupp-Grusonwerk was installed and placed in commission at the beginning of 1933. It handles about 100 tons of mine ore daily and is producing monthly about 25 tons of molybdenum concentrate running 85 per cent MoS_2.

Crude ore is first hand-picked, manual labor being cheap in Morocco. The flowsheet is shown in a cut. The ore is delivered by dump wagons, and goes to a Krupp jaw crusher, first passing over a grizzly of 50-mm. opening, the undersize rejoining the crushed oversize and both going to a bin. From this a feeder delivers the crushed ore to a belt which conveys it to a Universal vibrating screen which removes the minus 20-mm. material. The 20-50 oversize is divided between two picking belts on which waste is removed. The rest is crushed to 15 mm. in rolls, 750 mm. diameter by 300 mm. wide. Minus 20-mm. material, screened out, is stored in a bin, from which it is fed to a 1,550x 1,800-mm. tube mill for grinding prior to flotation.



Le Molybdène flotation plant, Morocco

Flowsheet of Le Molybdène flotation plant, Morocco



In closed circuit with the mill is a duplex rake classifier, having a rake width of 1,400 mm. Analysis of the slime overflow shows 75 per cent minus 250 mesh, 22 per cent plus 200 mesh, and 3 per cent plus 150. This is delivered by an air lift to an agitator in which the reagents are effectively mixed with the slime. Thus prepared, the flotation slime goes to three rougher Callow-McIntosh cells, each of 3-m. rotor length. The cells are placed in line with one another and discharge a practically clean tailing. The product of the first of these cells is delivered to three 2-m. cleaner cells, arranged in tandem. In these cells, by means of the triple flotation employed, the final molybdenum concentrate is obtained. Middlings are returned to the mixer. Table I gives results for a lengthy working period.

Flotation of the crude ore is difficult, because of the chalcopyrite content, which must not enter the concentrate, inasmuch as commercially the copper of the latter must not exceed 0.4 per cent. The process is therefore selective, the flotation of the chalcopyrite being hindered with depressing reagents, while, on the other hand, the molybdenite itself is practically all recovered.

The concentrate produced in the cleaner cells is collected in a spitzkasten, pre-thickened, and then dewatered in a Wolf disk filter of 1 sq.m. (10.7 sq.ft.) filter surface. The concentrates coming from the filter still have 15-18 per cent water. They are then completely dried on a drying hearth and despatched to Europe in iron barrels.

Power required is given in Table II.

Table I—Operating Results
Le Molybdène Flotation Plant

	MoS_2 %	Cu, %	MoS_2 Yield, %
Crude ore feed	1.08	0.05	100
Concentrate	85.15	0.02	91
Rock	0.10	0.06	9

Ratio of concentration 1 :79.

Table II—Power Requirements

	Hp.
Crushing and Picking Plant	
Jaw crusher, feeder, crushing rolls.	20
Three belt conveyors	6
Universal vibrating screen	2
Total	28
Grinding Plant and Flotation	
Feeder and classifier	4
Tube mill 1,550x1,800	55
Agitator	3
Six Callow-McIntosh cells.....	4
Two blowers	23
Filter plant	3
Total	92

COST OF HOISTING

Lowest at Porphyry Mines

Morris J. Elsing

Consulting Engineer
Tucson, Ariz.

SIZE, shape, inclination, depth, and distribution of the orebodies of a mine determine the method of shaft development and hoist equipment, and on these, in turn, largely depends the cost of hoisting per ton.

Shafts are vertical or inclined, or in rarer instances a combination of both. In inclined shafts, hoisting is done with skips; skips may also be used in vertical shafts, or a cage and a car. Some vertical shafts have one or two compartments for skip hoisting, and one or two compartments for cage and car hoisting. In smaller operations, a cage may be hung below the skip, or vice versa. This arrangement results in the most economical hoisting of ore, and allows greater flexibility in the transportation of waste. It likewise facilitates movement of men and supplies.

Under favorable conditions hoisting is a simple operation; under adverse conditions it becomes exceedingly complicated, and costly. The hoisting practice of the Tri-State district is an illustration of the former. It is, however, different from that of other mining districts. The ore occurs in flat horizontal beds of large extent, at depths rarely exceeding 300 ft. Vertical shafts, untimbered except at the collar, are sunk to the ore bed. Ore is trammed to the shaft in buckets or so-called "cans," which are mounted on low trucks. These cans are hoisted and dumped in much the same manner as in the normal process of shaft sinking. This method of hoisting is the most economical of all of the smaller operations, in point of operating expense as well as in capital outlay for shaft and hoisting equipment.

In mining operations in which the orebody is a large, flat-dipping bed or a flat-dipping vein, the shaft is sunk in the ore or just below it. This is the condition existing in the Michigan copper country, in the Birmingham, Ala., iron district, at Mascot and Ducktown, Tenn., at the North Star, Calif., as well as at many other smaller mines. When great depth is reached, such mines also require vertical shafts. Hoisting is sometimes done in two stages, with one hoist located underground. Such an arrangement usually necessitates provision of some form of mechanical haulage between shafts. This procedure, of course, doubles the cost of hoisting.

The following is a brief review of the economic aspects of hoisting at various mines:

Joplin District, A.I.M.E., Vol. 57—In 1917, H. I. Young stated that as many as 150 cans can be hoisted per hour from a depth of 250 ft. through a single-compartment shaft. The cost of hoisting is between 6 and 7c. per ton. Average costs for hoisting 136,272 tons in four months of 1917 are as follows: hoisting engineer, $0.017 per ton; tub hooker, $0.016; cable, $0.005; hoister repairs, $0.003; hoister derrick repairs, $0.001; shaft lacing repairs, $0.001; steam for hoister, $0.020; slickers for hoister, $0.001; oil and waste, $0.001. Total $0.065 per ton.

Tri-State District. "M. & M." June, 1930—Roy Berentz gives the following power costs of hoisting. Lift is estimated at 250 ft. Hoisting is done at the rate of 750 cans, containing 0.6 tons of ore, per 8 hr. The compressor has a capacity of 888 cu.ft. and is driven by a 150-hp. motor. The electric hoist is driven by a 75-hp. motor. Hoisting power cost per ton: Air hoist, 2.47c. per can, or 4.1c. per ton; electric hoist, 1.74c. per can, or 2.9c. per ton.

Hartley, Tri-State District. I. C. 6656—Two types of hoisting units are used. One is an electric hoist usually driven by a 125-hp. motor. The electric power schedule imposes a charge of $2 per horsepower per month on all motors used in shaft-hoist service. With the energy charge, the power charge for operating a 125-hp. hoist, hoisting 30,000 tons per month, is about $500 per month. On this basis, hoisting requires 1.7 hp.-hr., and the cost is about 1⅔c. per ton for power. To cut down this power cost, a gas-engine-driven hoist has been developed. This unit is very satisfactory and can be operated at less than one-third of the power cost of the electric-driven unit.

Cans are hoisted with a ⅝-in. steel cable of the non-spin type. The average life of a cable on this service is from 50,000 to 60,000 tons of ore hoisted, and the cable cost is from one-tenth to two-tenths of a cent per ton hoisted. In 1930, 180,212 tons was hoisted from a depth of 250 ft.

Acme, Waco, Tri-State District. I. C. 6150—Hoisting in the Tri-State district is generally done with 75-hp. low-voltage electric motors, which operate single-drum hoists. No guides or crossheads are used. Cans, each of 0.6-ton capacity, are hoisted and dumped on a dumping apron by the hoisting engineer. The empty can is lowered to the station, and a "hooker" detaches it and hooks on a full can. Hoisting varies from 200 to 300 ft. in depth. The total cost of hoisting per ton of ore from May 11, 1927, to Jan. 2, 1929, during which period 364,285 tons was hoisted, is as follows: labor, $0.062 per ton; supervision, $0.009; electric power, $0.012; supplies, $0.008; total, $0.091 per ton.

Mine No. 8, Southeast Missouri. I. C. 6160—A four-ton skip attached to 1¼-in. cables is hoisted through 568 ft. of shaft by a single-drum hoist, and dumped into a wooden ore-storage bin that feeds through metal chutes directly into standard railroad cars, for shipment to the main plant for milling. The shaft hoist is a single, rigid-drum type, with single reduction gear. Rope speed is 750 ft. per minute. The skip is equipped with a single-deck man cage above it. Cost of hoisting 168,089 tons is: operating labor, $0.031 per ton; repair labor, $0.007; repair material, $0.003; power, $0.004; total, $0.045 per ton.

Mascot, Mascot, Tenn. A.I.M.E., Vol. 72—Hoisting is done through the No. 2 shaft, which is vertical. It has two skip compartments, which operate in balance, and one cage compartment. Hoisting is done from a depth of 582 ft. Speed of hoisting skips and cage is 500 ft. per minute. Hoisting and skip-loading costs are 4.3c. per ton.

Old Bed and Harmony, Mineville, N. Y. I. C. 6092—Because of the number of auxiliary shafts necessary, many hoists are used underground. They are all electrically operated, but are of several different makes, and range from 600 hp., with a rope speed of 1,200 ft. per minute, to 22 hp., with a rope speed of 400 ft. per minute. Depth of the main auxiliary inclined shaft is 3,600 ft. The auxiliary shaft skips dump into ore

pockets off the main shaft, from which the ore is hoisted to the surface. The main shaft of the Harmony mine is vertical; that of the Old Bed mine is inclined. Cost of hoisting 770,000 short tons is: labor, $0.095 per ton; supervision, $0.008; electric power, $0.063; supplies, $0.047; total, $0.213 per ton.

Table I—Hoisting Cost Per Ton

Mine	Year	Tonnage	Max. Depth, Feet	Cost per Ton, Cents	Remarks
Joplin district	1917	136,272	250	6.5	Vert., cans
Acme Tri-State	1917	364,285	300	9.1	Vert., cans
No. 8, S. E. Missouri	1928	168,089	568	4.5	Vert., skips
Mascot	1923	212,990	582	4.3	Vert., skips
Montreal	1928	700,000	2,700	14.2	Incl. and vert. skips
Montreal	1928	500,000	2,700	17.0	Incl., skips
Mineville	1927	770,000	4,200	21.3	Incl. and vert. skips
United Verde Ext.	1928	275,212	1,700	15.1	Vert., skips
United Verde	1918	530,470	1,050	43.0	Vert., cars
United Verde	1919	110,487	1,050	3.4	Vert., skips
United Verde	1926	1,387,397	2,350	15.4	Vert., skips
Copper Queen	1914	659,102	1,550	7.1 (a)	Vert., skips, steam
Copper Queen	1914	659,102	1,550	18.9 (a)	Vert., cars
Bunker Hill & Sullivan	1930	445,475	2,000	11.5	Incl., skips
85-Mine, N. M.	1930	7,220	1,650	24.5	Vert., skips
Smuggler Union	1928	71,521	796	14.9	Incl., skips
Elko Prince	1917	21,674	300	19.6	Incl., skips
United Eastern	1917-24	732,000	1,298	27.5	Vert., skips
Mogollon	1922	50,144	500	30.1	Incl., skips
Argonaut	1929	7,800	7,800	51.9	Incl., skips
Beatson	1922-26	1,682,079	200	5.1	Vert., skips
Miami	1925-29	16,556,296	811	3.3	Vert., skips
Ray	1928	3,243,159	465	2.0	Vert., skips
Nevada Consolidated	1924	694,476	700	5.2	Vert., skips
Lucky Tiger	1924	60,000	400	16.0	Incl., skips

(a) Actual cost of hoisting ore at the Sacramento shaft was 7.1c. per ton. The operation of eight other shafts cost 18.7c. per ton, making a total hoisting cost of 26.0c. per ton.

Montreal, Montreal, Wis. I.C. 6369—Hoisting is done through three shafts, two of which are inclined and one of which is vertical. Maximum hoisting depth is 2,000 ft. All shafts are equipped with Kimberley skips, those in the inclined shafts having a capacity of 5 long tons, whereas the vertical-shaft skips have a capacity of 8 long tons. Hoisting speeds of skips are 1,200, 2,000, and 2,500 ft. per minute, respectively. For rope capacity, the practice is to use 10-ft. diameter drums with one overlap. Ropes are 1¼- and 1⅜-in. regular lay, with independent steel centers. Hoisting costs per short ton, 1928, shaft No. 4, comprised: labor, 6.6c.; power, 10.2c.; supplies, 0.2c.; total, 17.0c. Shafts Nos. 5 and 6: labor, 7.2c.; power, 5.3c.; supplies, 1.7c.; total, 14.2c.

Shaft No. 5 is vertical; Nos. 4 and 6 shafts are inclined. No. 4 hoist is steam driven, and shafts Nos. 5 and 6 are electrically equipped. In 1928, shaft No. 4 produced 450,000 long tons of iron ore, and shafts Nos. 5 and 6 produced 630,000 long tons.

85-Mine, Lordsburg, N. M. I.C. 6413—The Emerald shaft is equipped with a geared electric hoist installed in an underground hoist room on the adit level. Rope-load capacity is 8 tons; rope speed is 1,000 ft. per minute. The man-cage holds nine men, and is suspended under the skip. Ore is hoisted in 3-ton skips from the various pockets, all of which are equipped with air-controlled skip hoppers holding 3 tons of ore.

For the month of August, 1930, the cost of hoisting was as follows: labor, 9.8c.; supplies, 6.4c.; power, 8.3c.; total 24.5c. per ton. In addition to this, there was a charge of 9c. per ton for station tending and ore pockets.

United Verde Extension, Jerome, Ariz. I.C. 6250—This mine is operated through two vertical three-compartment concrete shafts and a large haulage adit located on the 1,300-ft. level. One shaft is equipped for ore hoisting, and the other is a service shaft. In the ore shaft, hoisting is done in 3-ton skips from the 1,700 level to a point above the 1,100 level. The skip is dumped by movable guides, which show red lights in front of the hoisting engineer when in the dumping position, and green lights when the shaft is clear. Ore can be dumped into one of three different pockets by an air-operated deflecting door. In 1928, production was 275,212 tons, a part of which came from the upper levels and required no hoisting. The total cost for hoisting in 1928 was 15.2c. per ton.

Copper Queen, Bisbee, Ariz. A.I.M.E., Vol. 52—Prior to the installation of the present transportation system the Copper Queen hoisted ore at six shafts. After the trolley-locomotive haulage system was installed, all ore was trammed to the Sacramento shaft, where it was hoisted in skips. This shaft is vertical and the hoist is operated by steam. Cost in cents per ton of hoisting in 1914 and for four months in 1915, respectively, were as follows: steam, 1.9, 2.3; electricity, 0.1, —; engineers, 0.9, 1.0; oilers, 0.5, 0.5; skip loaders, 1.2, 1.0; miscellaneous, 0.1, 0.4; hoist repairs, 1.3, 0.6; cage repairs, 0.4, 0.3; ore pockets, 0.2, 0.5; ropes, 0.5, 0.3; total, 7.1c., 6.9c. Tons hoisted in 1914, 659,102; for four months in 1915, 185,179.

In addition to the Sacramento shaft, eight shafts were operated to handle men, supplies, and waste rock. Four of these hoists were operated by preheated compressed air, two by steam, and two by electricity. Costs of operating these hoists, in cents per ton, in 1914, and for four months in 1915, respectively, were as follows: steam, 1.1, 1.0; air, 2.6, 2.2; air heaters, 0.3, 0.4; electricity, 0.4, 0.7; engineers, 4.9, 4.2; oilers, 1.1, 1.2; cagers, 4.7, 4.0; cleaning stations, 0.2, 0.2; hoist repairs, 2.0, 1.0; cage repairs, 1.0, 1.5; hoist buildings, 0.1, —; rope maintenance, 0.5, 0.9; total, 18.9c., 17.3c.

Cost of steam at power house was 45c. per 1,000 lb.; cost of air at power house, 1.8c. per 1,000 cu.ft., to 93 lb.; cost of electricity at power house, 1.59c. per kilowatt-hour.

As already stated, the cost of hoisting ore at the Sacramento shaft in 1914 was 7.1c. per ton. Including the cost of operating the service shafts, the total cost of hoisting was 26c. per ton of ore hoisted.

United Verde, Jerome, Ariz. A.I.M.E., Vol. 66—Prior to September, 1918, hoisting was done through Shafts Nos. 5, 3 and 4. About 1,430 tons of ore and 40 tons of waste were hoisted per day through shaft No. 3 to the 9th level. This came from between the 950 and 1,950 levels. Shaft No. 4 was used between the surface and the 1,000 transportation level. Some sticky ore was lowered to the 950 level. Both of these shafts were equipped with double-deck cages, which handled 18-cu.ft. cars. Total cost of all hoisting for 1918, when 530,470 dry tons was hoisted, was: labor, $0.181; supplies, $0.004; electric power, $0.003; boiler plant, $0.205; repairs, $0.037; total cost per ton of ore hoisted, $0.430; total cost per ton ore shipped, $0.265 per ton.

Table II—Segregated Hoisting Costs, in Cents Per Ton

Mine	Labor	Power	Supplies	Repairs	Total
Joplin district	3.3	2.0 (a)	1.0	0.2	6.5
No. 8 Missouri	3.1	0.4	....	1.0	4.5
Acme, Tri-State	7.1	1.2	0.8	....	7.1
Mineville, N. Y.	10.3	6.3	4.7	....	21.3
Montreal, Wis.	6.6	10.2	0.2	....	17.0
Montreal, Wis.	7.2	5.3	1.7	....	14.2
85-Mine, N. M.	9.8	8.3	6.4	....	24.5
Copper Queen	2.6	1.9 (a)	0.2	2.4	7.1
United Verde	18.1	20.8 (b)	0.4	3.7	43.0
United Verde	2.1	0.9	0.1	0.3	3.4
United Verde	6.0	3.3	0.7	5.4	15.4
Smuggler Union	7.9	1.3	0.1	5.6	14.9
United Eastern	18.4	5.0	1.4	2.7	27.5
Argonaut	25.3	10.9	15.7	....	51.9
Ray	0.8	0.7	0.3	0.2	2.0

(a) Steam. (b) Operating boiler plant.

In addition to the Sacramento shaft, eight shafts were operated to handle men, supplies, and waste rock. Four of these hoists were operated by preheated compressed air, two by steam, and two by electricity. Costs of operating these hoists, in cents per ton, in 1914, and for four months in 1915, respectively, were as follows: steam, 1.1, 1.0; air, 2.6, 2.2; air heaters, 0.3, 0.4; electricity, 0.4, 0.7; engineers, 4.9, 4.2; oilers, 1.1, 1.2; cagers, 4.7, 4.0; cleaning stations, 0.2, 0.2; hoist repairs, 2.0, 1.0; cage repairs, 1.0, 1.5; hoist buildings, 0.1, —; rope maintenance, 0.5, 0.9; total, 18.9c., 17.3c.

Cost of steam at power house was 45c. per 1,000 lb.; cost of air at power house, 1.8c. per 1,000 cu.ft., to 93 lb.; cost of electricity at power house, 1.59c. per kilowatt-hour.

As already stated, the cost of hoisting ore at the Sacramento shaft in 1914 was 7.1c. per ton. Including the cost of operating the service shafts, the total cost of hoisting was 26c. per ton of ore hoisted.

United Verde, Jerome, Ariz. A.I.M.E., Vol. 66—Prior to September, 1918, hoisting was done through Shafts Nos. 5, 3 and 4. About 1,430 tons of ore and 40 tons of waste were hoisted per day through shaft No. 3 to the 9th level. This came from between the 950 and 1,950 levels. Shaft No. 4 was used between the surface and the 1,000 transportation level. Some sticky ore was lowered to the 950 level. Both of these shafts were equipped with double-deck cages, which handled 18-cu.ft. cars. Total cost of all hoisting for 1918, when 530,470 dry tons was hoisted, was: labor, $0.181; supplies, $0.004; electric power, $0.003; boiler plant, $0.205; repairs, $0.037; total cost per ton of ore hoisted, $0.430; total cost per ton ore shipped, $0.265 per ton.

The authors of this article state: "These costs clearly indicate the uneconomical conditions of hoisting." A new ore-hoisting shaft, No. 5, and a large service shaft, No. 6, were sunk to

provide more economical hoisting. The average cost per ton of hoisting ore and waste through No. 5 shaft in the months of August, September, and October, 1919, was as follows, the total amount hoisted being 110,487 tons. This cost does not include service shaft hoisting: labor, $0.021; supplies, $0.001; electric power, $0.009; repairs, $0.003; total, $0.034 per ton.

United Verde, Jerome, Ariz. "M. C. J.," September, 1927—The main ore hoist at shaft No. 5 is an Allis-Chalmers, double-drum, single-reduction, geared-type unit, driven by a 650-hp. d.-c. motor, 500 volts, 300 r.p.m. Maximum hoisting capacity is 260 tons per hour. Rope speed is 890 ft. per minute. Skips, of 112-cu.-ft. capacity, hold 8 tons of sulphide ore and 6 tons of schist ore. Ore is hoisted to the 800 level and dropped into ore pockets just above the 1,000-ft. transportation level, through which it is trammed to the surface crushing plant. The deepest hoisting is from the 3,150 level. There are ore pockets on the 1,200, 1,500, 1,800, 2,100, and 2,400 levels. Costs include also the cost of operating the No. 6 service shaft and miscellaneous hoisting equipment throughout the mine. They were: labor, $0.060; air, $0.007; power, $0.033; repairs, $0.054; total, $0.154 per ton.

Bunker Hill & Sullivan, Kellogg, Idaho. I.C. 6407—This mine is served by two shafts. Shaft No. 1 is the ore-hoisting shaft and No. 2 is the service shaft. They are both inclined, the former dipping at 50 deg. and the latter at 40.5 deg. No. 1 shaft has three compartments, and hoisting is done from the 1,900 level to the 9th level, which is the Kellogg tunnel level. Levels are 200 ft. vertically apart. Ore and waste are hoisted in skips of 5 tons' capacity. The ore hoist has a double drum, with both drums clutched, and is driven by two 2,200-volt, 60-cycle, 300-hp., variable-speed motors. The maximum rope speed for ore hoisting is 1,000 ft. per minute; and for men, 500 ft. Ore is loaded from skip pockets. Ore hoisting costs, in cents per ton, from annual reports, is as follows: Total hoisting—1930, 11.5; 1929, 8.0; 1928, 6.8; 1927, 7.1; 1918, 8.1; 1913, 5.9. Hoist and skip men—1930, 4.3; 1929, 4.3; 1928, 3.7; 1927, 3.6; 1918, 4.7; 1913, 3.5c. per ton.

Smuggler Union, Telluride, Colo., "E. & M. J.," Oct. 23, 1930—Inclination of this shaft was 58 deg. The ore was loaded from shaft pockets into a 70-cu.ft. skip, which was operated with a counterbalance. Hoisting was done from the 12th, 13th, and 15th levels. Average distance of hoisting on the slope was 796 ft. vertically. A total of 71,321 tons was hoisted from May to September, inclusive, 1928. The following costs per ton include the total operation of hoisting ore; lowering timber, supplies, steel, and powder; and raising and lowering men: Operation—cagers and skip tenders, at $6.946, $0.045; hoist men, at $5.32, $0.034; power, $0.013; oil, grease, "cable dope," $0.001; total operation, $0.093 per ton. Repairs—labor, carpenters, and shaft men, $0.022; labor, shop, $0.017; supplies, $0.017; total repairs, $0.056; total hoisting, $0.149 per ton.

United Eastern, Oatman, Ariz. A.I.M.E., Vol. 76—The installation at the Tom Reed Extension shaft consisted of an Allis-Chalmers double-drum electric hoist, direct-connected to a 150-hp. motor through flexible coupling and herringbone gears. Ore was hoisted in skips working in balance, each skip being suspended below a cage used to hoist waste in cars as well as to hoist men and supplies. The skip loads averaged 2.2 tons each, and the maximum hoisting speed was 800 ft. per minute. A Wellman-Seaver-Morgan Company hoist of like capacity was used at the Big Jim shaft.

Maximum depth of hoisting at the Tom Reed Extension was 1,300 ft., and at the Big Jim, 750 ft. Costs for hoisting 732,000 tons of ore from 1917 to 1924, inclusive were: labor, $0.184; supplies, $0.014; power, $0.050; miscellaneous, $0.027; total, $0.275 per ton.

Elko Prince, Midas, Nev. A.I.M.E., Vol. 60—In 1917, 60 tons was hoisted per day from the 600 to the 300 level by a Denver Engineering double-drum electric hoist, with a counterweight. It was driven by a 10-hp., 550-volt, d.-c. motor, and had a hoisting speed of 150 ft. per minute. The complete cycle took 5 min. The self-dumping skip weighed 1,200 lb., and had a capacity of 35 cu.ft. Trammers dumped the cars directly into the skip through a chute. The shaft pocket was located on the 300 adit tunnel level. Cost for hoisting in 1917 was $0.196 per ton.

Mogollon District, N. M. A.I.M.E., Vol. 72—Both the Last Chance and Fanney mines were equipped with double-drum electrically driven hoists, made by the Denver Engineering Works. Skips held 1.5 tons of ore. The equipment was designed to hoist 200 tons in 8 hr. from the 500-ft. level. A low hoisting speed was used to reduce the power required to the minimum. The motor used was 40-hp., 440-volt, 3-phase, 60-cycle, slip-ring type. The Last Chance shaft was inclined, and the Fanney was vertical. Hoisting was done in skips. In 1922, 50,144 tons of ore was broken and 4.904 ft. of development work done. The total cost of hoisting was 30.1c. per ton, 5.4c. being for development.

Table III—Kilowatt-Hours Per Ton Ore Hoisted

Mine	Reference	Max. Dist., Ft.	Car or Skip	Vertical or Inclined	Kw.-Hr. per Ton
No. 1, Tri-State	L.C. 6113	200	Cans	Vert.	2.8
No. 2, Tri-State	I.C. 6121	300	Cans	Vert.	2.4
No. 3, Tri-State	I.C. 6174	200	Cans	Vert.	2.8
Hartley, Tri-State	I.C. 6656	250	Cans	Vert.	1.6
S. E. Missouri	I.C. 6170	245	Cars	Vert.	(a) 0.5
Daisy, Ill	I.C. 6384	640	Skips	Vert.	6.2
Hillside, Ill	I.C. 6294	550	Skips	Vert.	1.2
No. 1 Marquette	I.C. 6138	1,000	Skips	Vert.	1.8
No. 2 Marquette	I.C. 6179	1,650	Skips	Vert.	2.1
No. 4 Marquette	I.C. 6390	1,060	Skips	Vert.	1.6
No. 5 Marquette	I.C. 6380	1,200	Skips	Vert.	2.5
No. 1 Menominee	I.C. 6180	1,200	Skips	Vert.	3.3
Mineville, N. Y.	I.C. 6092	4,200	Skips	Both	4.2
Mineville, N. Y.	A.I.M.E. Vol. 72	4,200	Skips	Both	4.8
Montreal, Wis.	I.C. 6369	2,700	Skips	Vert.	4.0
Page, Idaho	I.C. 6372	1,200	Skips	Incl.	2.7
Hecla, Idaho	I.C. 6232	2,000	Skips	Vert.	4.4
Cortez, Nev.	I.C. 6327	240	Skips	Incl.	9.4
Copper Range	A.I.M.E. Vol. 72	2,000	Skips	Incl.	4.1
Homestake, S. D.	A.I.M.E. Vol. 72	2,300	Skips	Vert.	2.1
Mascot, Tenn.	I.C. 6239	582	Skips	Vert.	1.1
United Verde	A.I.M.E. Vol. 72	1,500	Skips	Vert.	1.1
United Verde	M.C.J. Sept., '27	2,350	Skips	Vert.	0.8
Old Dominion, Ariz.	I.C. 6237	2,600	Skips	Vert.	9.8
Argonaut, Calif.	I.C. 6311	5,800	Skips	Incl.	9.9
Plymouth, Calif.	A.I.M.E. Vol. 72	3,000	Skips	Inc.	10.7
Mary, Tenn.	I.C. 6397	900	Skips	Vert.	(b) 12.2
Black Rock Butte	I.C. 6370	3,000	Skips	Vert.	10.3
Bunker Hill & Sullivan	A.I.M.E. Vol. 72	2,000	Skips	Incl.	13.1
Tintic Standard	I.C. 6360	1,300	Cars	Vert.	(c) 15.4
Miami, Ariz.	A.I.M.E. Vol. 72	796	Skips	Vert.	1.3
Morning, Idaho	I.C. 6238	2,250	Skips	Vert.	4.4

(a) Questionable; too low. (b) Estimated from 81.1 lb. coal per ton ore hoisted. (c) Distribution on direct labor basis.

The hoist drums are 8 ft. in diameter with 47-in. faces, and they carry 10 layers of 1⅛-in. diameter, 6-strand, 19-wire, hemp-core, crucible-steel hoisting rope. The hoist is driven by a 500-hp., 440-volt, 60-cycle, 3-phase, 440-r.p.m. (at full load) induction motor. Maximum hoisting speed is about 900 ft. per minute. Direct cost of hoisting 7,800 tons in September, 1929, was as follows: labor, 25.3c.; power, 10.9c.; supplies, 15.7c.; total, 51.9c. per ton.

Argonaut, Amador County, Calif. I.C. 6311—The Argonaut mine has a 70-deg. inclined three-compartment shaft, 5,800 ft. deep. Hoisting is done in balance with self-dumping skips having a nominal capacity of 72 cu.ft., or 4 tons; the average amount of ore hoisted is 7,100 lb. per trip. Track in the shaft is of 40-lb. rails laid to a gage of 30 in. Flow of ore into the skips from the shaft pockets is controlled by hand-operated rack-and-pinion gates.

The hoisting engineers' wages were

$6.25 per day, and power consumption for hoisting was 9.9 kw.-hr. per ton of ore. An auxiliary shaft is also maintained for ventilation purposes and for the escape of workmen in case of necessity.

Miami Mine, Miami, Ariz. A.I.M.E. T. P. 314—The ore is hoisted in the crusher-plant bins a vertical distance of 811 ft. in 10.5-ton skips, which are loaded from the ore pocket through an automatic measuring cartridge operated by the skip tender. He also puts the skips in motion when loaded, through a pushbutton control, after which the acceleration, retarding, and dumping of the skip are automatic, no hoist engineer being required. Maximum speed of the hoist is 2,250 ft. per minute, and the trip is made in 38.5 sec. Time required for loading and dumping is 3 sec. Maximum capacity of the hoist is 950 tons per hour, and the power required is approximately 1.3 kw.-hr. per ton hoisted. Men, supplies, and waste rock are handled on a single-deck counterbalanced cage operating in a compartment 6 ft. 6 in. by 13 ft. Underground hoisting between levels is handled by one large, warehouse-type elevator, with a single deck large enough to handle all mine supplies and equipment on trucks without transferring. Men are handled underground, between levels not connected with the main shaft, by an automatic elevator with pushbutton control, similar to the elevators used in apartment houses. Total cost of hoisting from Oct. 1, 1925, to September 30, 1929, when 16,556,296 tons of ore was mined, was 3.32c. per ton of ore hoisted. Estimated cost of hoisting ore in 1916 (A.I.M.E., Vol. 55) was 4c. per ton.

At Ray

Ray, Ray, Ariz. I. C. 6167—Ore is loaded into the skips through measuring hoppers; skip capacity is 450 cu.ft.; average load is about 10.5 dry tons. At the collar of the shaft the skips dump into a 100-ton steel bin over the coarse-crushing plant. One ore-hoisting shaft is at mine No. 2, the collar of which is 465 ft. above the bottom haulage level. Supplies are handled through an inclined service shaft. Cost per ton of hoisting 3,243,159 tons in 1928 was: labor, $0.008; power, $0.007; machine shop, $0.002; miscellaneous, $0.003; total, $0.020.

Beatson, Latouche, Alaska. A.I.M.E., Vol. 76—The main shaft was served by a Wellman-Seaver-Morgan double-drum geared electric hoist, driven by a 150-hp., 2,300-volt, Westinghouse motor. Hoisting speed was 600 ft. per minute. The skips, each holding 4 tons of ore, were loaded through measuring hoppers and dumped directly into the mill crusher bins. Hoisting was done from the 200-ft. level. Cost was 5.1c. per ton for hoisting 1,682,079 tons during 1922 to 1926, inclusive.

Lucky Tiger, El Tigre, Son., Mexico. A.I.M.E., Vol. 72—The main hoisting shaft is underground. The hoist is geared to a 50-hp. slip-ring induction motor; 2,200-volt power is transformed at the hoist to 440 volts. Between the 7th and 10th levels the shaft dips at an angle of 54 deg. Below the 10th level it is vertical. Ore and waste pockets are located above each level. The skip has a capacity of 32 cu.ft. Cables are special steel, $\frac{3}{4}$ in. diameter. The hoist, operated on three shifts, handles 200 tons of ore and waste per day, as well as all timber, steel, and supplies for the lower levels. Hoisting costs 16c. per ton of ore and waste hoisted.

Summarizing

Principal data presented in the foregoing are summarized in Table I. Hoisting costs are usually segregated under four headings—namely: labor, power, supplies, and repairs. Such detailed costs as are available are shown in Table II.

In segregating hoisting costs the hoisting engineers, skip tenders, and cagers, and in some cases the top landers, are included under the head of "Labor." In cage and car hoisting, each cage requires one cager and one top lander—under some conditions more than one. Where cages are of double- or triple-deck construction and operate in two compartments, two cagers, or possibly three, work together while loading ore cars, and the top landers remove and tram them to the ore bins. If waste is loaded for delivery to another level the cagers separate; one loads and the other unloads. In skip hoisting, where ore or waste is hoisted from numerous levels, one skip man (and sometimes more than one) attends to loading when the operation of unloading is done automatically.

An important function of hoisting is the lowering and raising of men and supplies. In most large operations a service shaft is provided for this work. Prompt man service is important. Even in the best-regulated mines there is usually considerable "running around"—a constant procession of shift bosses, samplers, engineers, pipe and track men, pump men, electricians, and other specialists going from level to level. The tendency has been to provide special shafts for this type of service. These shafts in the largest mines have one large compartment with a cage of sufficient size so that a truck loaded with timber or other supplies can be run onto it. This type of cage is also efficient in lowering and raising men when they go on and come off shift. In many states the 8-hr. day runs from "collar to collar." Speedy transportation, therefore, is a matter of importance. In inclined shafts, men are lowered and hoisted in man skips that replace the ore skips at the beginning and end of the shift.

Adequate hoisting facilities are important. This is especially true when hoisting is done with a cage and cars. Unless ample cars are provided on each level, a slight delay in hoisting will result in having all cars filled, and trammers will be idle until the station is cleaned up. Several such delays during the shift may cause stope chutes to become filled, and prevent the completion of mucking in drifts. When hoisting is done by skips that are loaded from skip pockets somewhat more leeway is assured, as pockets are usually sufficiently large to hold a considerable part of the day's production. This is one of the reasons that skip hoisting from pockets is so largely replacing the older cage and car method of hoisting.

Hoisting power is usually electricity, which has largely replaced steam. Compressed air is occasionally used. Gasoline hoists are common only in the smaller prospects. The labor cost of hoisting is usually two or three times as much as the power charge. When power is purchased from a power company, a service charge is usually made of, perhaps, $2 per month per horsepower of each hoist motor operating. This is in addition to the energy charge. Electric-power consumption in kilowatt-hours per ton of ore hoisted, is shown in Table III for 30 different mining properties.

Variable Items

Cost of supplies and repairs is exceedingly variable, and no general conclusions may be drawn except that the installation of first-class equipment reduces these items to a minimum. The use of obsolete, worn-out equipment seldom proves to be economical, and this is especially so with hoisting equipment. The main supply items are cotton waste, oil, grease, and "cable dope." Periodically to replace hoisting cables is, of course, necessary. Life of a cable depends entirely upon the type of cable used and the local operating conditions. The hardest conditions to which a cable can be put are usually to be found in an inclined shaft of varying inclination. Add to these the disadvantage of acid water, and the life of the cable is short. An ample supply of cable rollers and frequently application of cable grease will greatly aid in prolonging its life. The greatest wear occurs at different lengths of the cable. To overcome this, a short piece of cable should be periodically cut off; this spreads the wear. Before being discarded, cables are sometimes turned end for end. Cables may generally be safely used even after strands show considerable wear. How far this can continue depends largely upon the rated strength of the cable and its load. The first appearance of broken wires is usually the signal for more careful observation. To secure maximum use out of the cable with safety, one of the several well-recognized rules for its replacement should be followed.

The costs presented in Table I show a wide variation. Certain general deductions, however, can be made. Average hoisting costs of the porphyry group can be taken at about 3c. per ton. Another low-cost group is composed of the mines of the Tri-State district, in Southeast Missouri, and Mascot, Tenn. Approximate cost of hoisting for this group is 5.5c. per ton. Cost of hoisting for the largest group of miscellaneous mines is from 15 to 20c. per ton. A smaller number of mines show costs of from 25 to 30c. per ton. One mine shows the high cost of 51.9c. per ton.

That the porphyry mines should have the lowest costs is logical. The operation of loading skips, hoisting, and dumping in some instances are almost automatic. Attendants are required rather than operators. In addition to a low direct operating cost, the additional cost of one service shaft, or more than one, is spread over a large tonnage, and is consequently only a small additional charge to hoisting. Under certain conditions the operation of the necessary service and auxiliary shafts is a large part of the total hoisting cost. This is so at Copper Queen, where the ore hoisting costs were 7.1c. per ton and the service-shaft operations added 18.9c. per ton to the cost of hoisting.

The simplicity of the hoisting operations in the Tri-State district, and the shallow depths, account for the low costs obtained there. Other small mines may have comparatively low costs. Ground conditions, water, and other factors have an influence on hoisting costs. If hoisting can be confined to the actual operating shifts, a considerable saving is effected. In other words, if two shifts are worked in the mine, the operation of the hoist on the graveyard shift may be avoided. If however, ground conditions, in the shaft or in the haulage drifts, necessitate doing the repair work during off-shift times, the hoist must be operated. If water must be pumped constantly, the hoist must be operated, as custom dictates that one hoist be manned whenever men are underground. What has been said about not operating the hoist on the graveyard shift also applies to days when the mine is not worked, such as Sundays, holidays, and change days. If the services of hoisting engineers and cagers can be dispensed with during these periods, an appreciable saving can be made in cost of hoisting.

To a certain extent the cost of hoisting is dependent upon the method of mining. In square-setting, the lowering of timber is no small item. The amount of development is another variable item that directly effects costs. No satisfactory method is available for comparing hoisting costs, such as by the ton-mile basis of haulage. This is mainly because local operating conditions affect hoisting in a different way than they do haulage and other operations. If ore hoisting could be separated from waste hoisting and from service hoisting, a closer similarity of costs would be apparent. Usually this would be impossible, and probably of doubtful value. The one obvious fact is that in most mining districts, excepting the Tri-State, electric hoists and skips have proved the most economical method of hoisting.

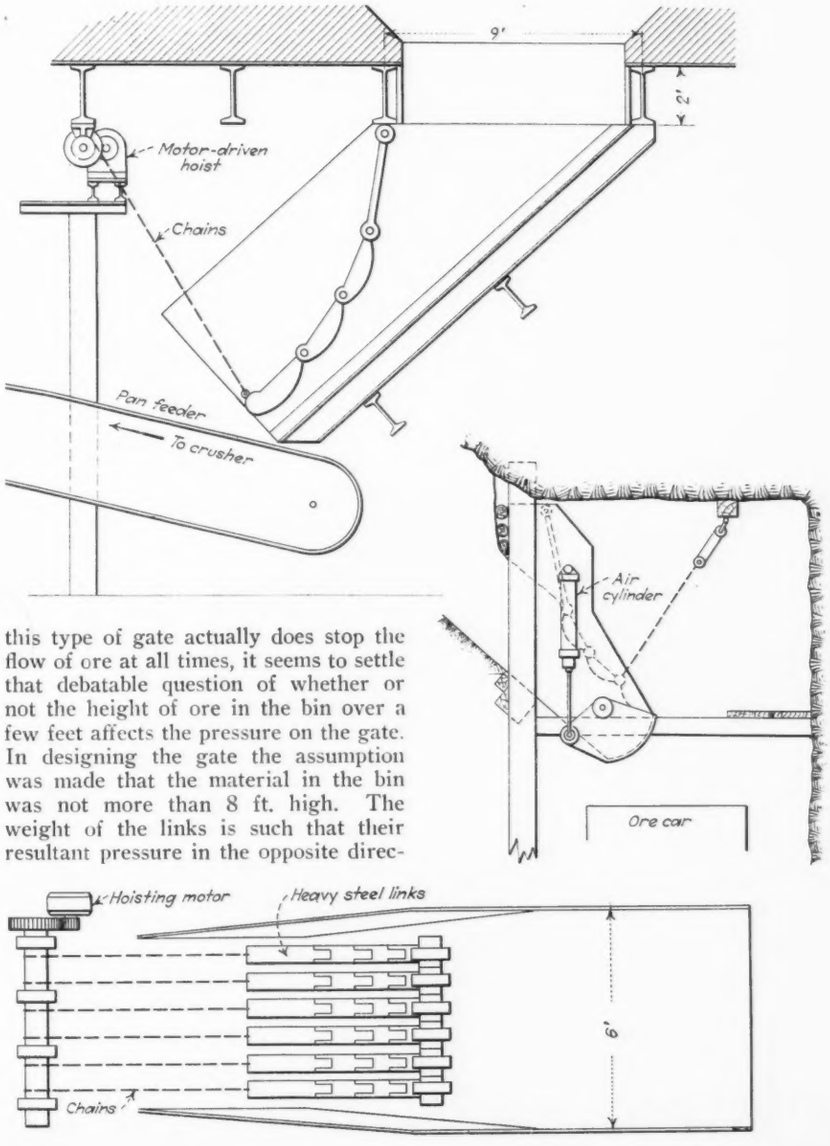
New Link Ore Gate

THE ore gate shown in the accompanying illustrations was devised to control the flow of large heavy rocks that weighed in the broken state about 160 lb. per cubic foot and were up to 2 ft. in diameter, writes George K. Williams, designing engineer, who recently joined the staff of the Cyprus Mines Corporation, operating at Skouriotissa, Nicasia, Cyprus.

Installed at the bottom of an ore bin 30 ft. high, with a 5x7-ft. opening, the gate served as a shut-off and control device for a 60-in. pan feeder that discharged to a large gyratory crusher. The gate cannot jam, and the spaces between the links permit barring of the rock if it arches over the opening. As this type of gate actually does stop the flow of ore at all times, it seems to settle that debatable question of whether or not the height of ore in the bin over a few feet affects the pressure on the gate. In designing the gate the assumption was made that the material in the bin was not more than 8 ft. high. The weight of the links is such that their resultant pressure in the opposite direction to the flow of ore down the chute gives an ample margin of safety.

In lowering the gate to shut off the ore flow, fine material will dribble through for a few seconds only. Raising or lowering the links regulates the amount of material passing to the pan feeder.

For underground work where ore cars are to be loaded from a chute and no spilling can be permitted, the same system of links may be used in conjunction with the undercut type of quadrant gate. This arrangement provides a quick cut-off and, at the same time, gives the desired facility of barring the opening, with safety to the operator.



Sulphur in Peru

Some Deposits of the Andes

Robert D. Ferron

Consulting Mining Engineer,
Arequipa, Peru

MOST treatises on sulphur make no mention of deposits in southern Peru. Presence of sulphur across the line in Chile is usually noted, owing to the fact that the deposits there have been worked commercially. Similar occurrences in Peru appear to be relatively unknown, presumably because these deposits have not been worked since colonial times, except in a small way by local Indians, who use sulphur for medicinal purposes. Most of the Peruvian deposits have not even been properly prospected as yet. The following notes are intended to supply a brief description of some of the sulphur deposits discovered in Peru:

Tolopama deposit. Pit in foreground

Mount Tucsacota deposit

Outcrops on the Llocumani deposit

The deposits are found near certain of the high volcanic peaks in the main Western Range of the Andes Mountains, between the town of Arequipa and the Chilean border. They occur at high altitudes that vary from 13,000 ft. to 18,000 ft.

On the Chilean side of the line, sulphur deposits have been worked in this range at several points between the Antofagasta district and Mount Totora, which is just south of the Peruvian boundary line. The Totora deposit has been operated for several years by the Cia. Azufrera del Pacifico, which company ships from Arica.

Crossing over into Peru, the first deposit of importance is Tuquila, about 20 km. north of the Arica-La Paz Railway. The sulphur outcrops along the sides of a gulch, over a length of about 1 km. This deposit has not been prospected.

Following the line of volcanic peaks to the north, two important deposits are found on the flanks of Mount Tucsacota, near the town of Torata. Both of these deposits have been somewhat prospected by shallow pits, 1 to 3 m. in depth. Only a few of these pits have been carried to the full depth of the deposits, owing to the heat and gases encountered. Enough work has been done, however, to indicate the probability of encountering several million tons of sulphur ore in these two deposits.

About 20 km. further to the north are found two deposits on the flanks of Mount Llucumani, not far from the town of Candarave. These have not been prospected. Sulphur outcrops over considerable areas in both instances.

The next known deposits are on the flanks of Mount Tutupaca, 30 km. to the north. At Tutupaca, sulphur ore outcrops along the sides of a gulch, over a length of nearly 1 km. No prospecting pits have been sunk.

Between Mount Tutupaca and Mount Ubinas to the north, little or no prospecting for sulphur has been done. No doubt similar deposits occur in this section of the range also. At Ubinas, sul-

phur deposits have been opened up, but not exploited, by the Lampa Mining Company. Smaller deposits are also known to occur on Mount Pichu-Pichu, near the town of Arequipa.

The high region containing the sulphur deposits consists almost entirely of igneous rocks. Both intrusive and extrusive types are found, lavas and scoriæ being particularly abundant. Hot, sulphurous springs are frequently encountered in the vicinity of the sulphur outcrops, indicating that volcanism has not entirely ceased. None of the volcanoes appears to be active at present.

The deposits themselves are of the solfatara or volcanic vent type. The origin of such deposits is commonly ascribed to a reduction of hydrogen sulphide gas. When pits are sunk in the sulphur ore, the material becomes increasingly warm with depth, and so gaseous as to make sinking difficult to a depth of more than 2 or 3 m.

All of the deposits observed outcrop near the bottom of steep slopes, continuing on down into flats or gently sloping gulches. As seen from a distance, they give the impression of having been formed by overflow in a molten state from a vent near the top of the deposit. At the upper end of the deposits the sulphur is usually clean and crystalline, and the bed is usually deep at this point. The deposits thin out toward the margins, and become increasingly dirtier with ash and dust.

The sulphur consists of thick beds, lying on the surface, or covered with thin layers of slide rock or dust. Occasionally, filled fissures below the main beds give the impression of veins of sulphur. The flat beds are often separated by horizontal bedding planes, with sometimes thin beds of volcanic ash separating the layers of sulphur. The deposits give the impression of successive flows of molten sulphur from the same vent, with quiescent periods between the flows.

In the deposits here described the sulphur content varies from over 90 per cent sulphur, at the upper ends, to as low as 25 per cent sulphur at the margins. An approximate average for all of the deposits would be about 50 per cent sulphur. The remainder of the material in the deposits is largely insoluble, being probably siliceous volcanic ash. Climatic conditions are much more favorable than in the instance of the more southerly deposits.

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A Correction

A. M. Gaudin directs our attention to the fact that in his article "Unusual Minerals," presented in the issue of December, 1933, the illustrations numbered, respectively, Fig. I and Fig. 7 were interchanged. The correction which he has so courteously made is gratefully appreciated.

Transfer Raises

Practice at Miami

A. J. McDermid

Mining Engineer,
Miami, Ariz.

DRIVING of transfer raises at Miami is an important part of development because more than 1,000 linear feet of raise is required per month to fulfill scheduled requirements when the mine is working at capacity. A pair of standard transfer raises, as driven at Miami, are shown in Fig. 1. In cross-section the raises are 4x4 ft., and, where the ground will not stand without support, they are timbered with 6x8 in. cribbing, 4 ft. long in the clear.

Each pair of raises is driven by two machine men, working as partners on bonus. Each man takes one raise and drives it with such assistance from his partner as may be required. Drilling is done with Ingersoll-Rand CAW31 wet stopers—light, hand-rotated machines. The self-rotating machines have also proved satisfactory, especially in hard ground.

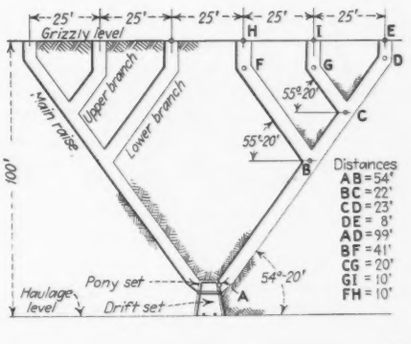
The type of lubricant used in the drills was first developed, so far as I can ascertain, by J. S. Conniff, supply engineer at Miami Copper. It is now marketed by several of the principal oil companies, and is finding much favor, especially where line oilers are used. The lubricant at present used by Miami Copper is that sold by the Shell Oil Company. It is a mixture containing, for summer use, 50 per cent of Gearex grease and 50 per cent of No. 500 pale compressor oil. For winter use, the percentages of grease and oil are 40 and 60, respectively. The Texaco product is 75 per cent Altair oil and 25 per cent Texaco cup grease No. 00. Altair oil is a straight mineral oil, viscosity 500 to 530 at 100 deg. F. The cup grease is a lime-soap-base grease, insoluble in water, made from low-coal-test mineral oil. Melting point of the grease is 170 deg. F. and the consistency is 300 to 360. Percentages given are those recommended by the Texas Company but may be varied to suit conditions. The lubricant is fed automatically through line oilers inserted in the air lines at the pony sets.

From seven to ten 4- or 5-ft. holes constitute a round. Usually one stick of 40 per cent gelatine dynamite is used for each foot of hole drilled. Rounds are blasted electrically, except for the first few rounds from the pony set, which are blasted with fuse to protect the timber. Before a round is blasted, the drill and hoses are dropped down the manway a short distance and covered. Current for blasting, from the d.c. underground power line, passes through two switches: the main blasting switch, which is kept locked when not in use, and an interrupter switch, which is simply a break in the circuit and is kept open except when the round is to be blasted.

When a raise has been driven within 40 ft. of the level with which it is to connect or within 40 ft. of any other accessible workings, no rounds are blasted until those workings have been cleared of men and all approaches guarded. Arrangements for guarding must not be made over the telephone. The boss in charge of the raise sends a note to the boss in charge of the workings to be guarded, giving the location of the raise and the time of the proposed blast. The last-named boss places guards and blasting signs at all approaches and orders all men away from the vicinity of the blast. He then O K's and signs the note, and sends it back to the raise boss, who then gives the word to blast.

Raises are driven on day shift only, as a rule, and blasting is usually done toward the end of the shift so that the night shift train crews can pull the broken muck from the raises and the smoke be allowed to clear out before the next day. Each round of muck must be removed before the raise can be entered, because, although the raise is divided into two compartments, the manway is not tightly lagged off from the muck compartment, and entrance to

Fig. 1—Section showing pair of standard transfer raises



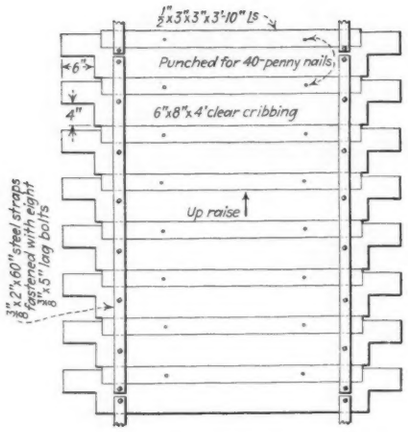

½"x3"x3"x3'-10" ls
Punched for 40-penny nails
6"x8"x4' clear cribbing
Up raise
3/8"x2"x60" steel straps fastened with eight 3/8"x5" lag bolts

Fig 2—Plan of cribbing as laid in bottom of transfer raise

both compartments is through the chute mouth. If the manway were completely lagged off, muck could be kept in the raise without preventing entrance, but to maintain such manway in an inclined raise is time consuming and expensive. Some muck is bound to fall down the manway, and this would clog the entrance to the raise if the manway were sealed off from the muck compartment. Also, a timber slide would have to be carried in the manway, and, in a raise only 4 ft. wide, a manway with a ladder and a slide would leave little room for a muck compartment. Under the existing arrangement, the timber is hoisted through the muck compartment without a slide. An objection to storing muck in the raise is that some Miami rock, if left too long in the raise, tends to pack and hang up.

Surveyor's Lines

The division between compartments consists of 6x8-in. stulls, spaced 10 ft. apart and boarded up about half way with 2x10-in. by 10-ft. plank. The manway is just wide enough for the ladder, which is nailed to the stulls far enough above the floor of the raise so that muck will not catch in the rungs. A 1-in. air line and a ½-in. water line are also fastened to the stulls. If the raise is cribbed, the surveyor puts his line spads in the back cribbing and his grade spads in the side cribbing of the muck compartment. If the raise is "raw," lines are carried in horizontal stulls placed about a foot above the floor of the raise. This practice has been found to be better than driving wooden plugs in the back of the raise for the line spads. Lines in stulls are less likely to creep than those in sets, as a stull usually stays exactly in place or else falls out altogether.

If the last round in connecting a raise to the grizzly level is drilled and blasted from below, experience has shown that the connection is likely to be too large in cross-section. The practice therefore is to sink a winze 4 ft. deep at the place in the drift where the raise is to break through. A 6-ft. vertical plugger hole is then drilled in the center of the bottom of the winze and the drill steel is left in the hole. When the raise man encounters the end of this steel he knows just how much farther he has to go to break through, and, if his raise has run a little off line or grade, he can bring it back in this last round. The vertical sections at the upper ends of the raises are another aid in keeping the connection small. If it is too small for the ore to pass through, it can easily be plugged out to proper size, but a large connection requires excessive timbering around the grizzly and is a source of trouble throughout the life of the stope.

If a raise has to be timbered, a Little Tugger air hoist is set up in the pony set above the haulage level drift. Timber for the raise is stored along the haulage drift. By tying two ropes to the throttle and letting them hang down into the drift, the man who is sending up the timber can operate the hoist and tie on the timber without his being required to climb back and forth between the pony set and the drift floor. The wire rope from the hoist, $\frac{5}{16}$ in. in diameter, passes up the raise and through a snatch block which is hung on a hook shaped to fit over the last round of cribbing in place. On the end of the wire rope is a small chain with a ring in the end of it, so that the cribbings can be tied on with two half hitches. To the end of the chain is tied a ½-in. hemp rope, which is used for pulling the wire rope back down the raise after a load has been hoisted. Both the idea of tying the ropes to the hoist throttle and that of the hook shaped to fit over the cribbing were contributed by miners in the raises.

To protect the cribbing from attrition by the ore, ½x3x3-in. steel angles, 3 ft. 10 in. long, are used. The total tonnage passing through a main raise below the branch junctions is about 100,000 tons, which does not wear the angles down badly, and, as they are expensive, they are installed so as to be readily reclaimed when the raise is abandoned. Both legs of the angles are punched in two places for 40-penny nails, but only the exposed leg is nailed to the cribbing. After a number of rounds of cribbing and their angles are in place, $\frac{3}{8}$x2x60-in. steel straps are placed over the ends of the angles, as shown in Fig. 2, in which a plan view of the cribbing for the bottom of the raise is reproduced. The straps are fastened to the cribbing with $\frac{3}{8}$x5-in. lag bolts. Angles are placed on the cribbing only at points of greatest wear. In most of the raise no angles are placed on the back cribbing, and on the sides and bottom only every other round is protected. As the lag bolts are in the corners of the raise where the wear is least, the heads do not readily wear off. Practically no trouble has been experienced from angles coming loose.

To recover the straps and angles when a raise is to be abandoned, the lag bolt heads are cut off with a pneumatic chisel. Then the angles can readily be pried out, as they are not fastened on the leg that lies between the cribbings. A crew of two men will ordinarily recover 100 straps and angles in a shift. When one leg of an angle has been worn nearly through, that leg can be placed between the cribbings in the next installation, leaving the unworn leg exposed. Other methods of protecting cribbing that have been used are as follows:

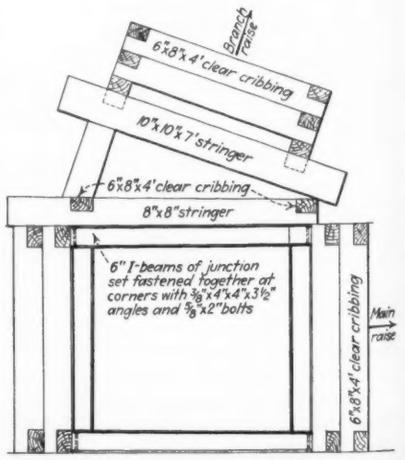
Three Forms of Procedure

1. Lining the raise with 2-in. plank. First cost is less than that of angles, but repair and replacement cost is high and the method is not to be considered except where the ore is especially soft. This method is still used in rare instances.

2. Use of 5-ft. lengths of 16-lb. rails, held in place in notches in the ends of the cribbing and lying parallel to the cribbing. Pounding of the ore bent these rails so that the ends slipped out of the notches. This method is no longer used.

3. Use of rail sections, built like sectionalized track but with three 16-lb. rails spaced 8 in. apart, and with ¼x3x24-in. steel plates used for ties, which are held in place with lag bolts through the rail bases and through the plates. These sections are cheaper in first cost than the angles, but the labor cost of installation is higher. Their defects are that blasting in the raise causes them to curl up; they are difficult to recover; and fewer of them are worth recovering, as compared with the angles. Rail sections are still used for raise protection to some extent, because some of them are still on hand and the angle method has not been thoroughly proved the cheaper

Fig. 3—Timbered raise showing steel junction set


Branch raise
6"x8"x4' clear cribbing
10"x10"x7' stringer
6"x8"x4' clear cribbing
8"x8" stringer
6" I-beams of junction set fastened together at corners with 3/8"x4"x4"x3½" angles and 7/8"x2" bolts
6"x8"x4' clear cribbing
Main raise

of the two. Few of the angles have been used in more than one raise.

Cribbing is laid in the form known in Miami parlance as the "picture frame": the side cribbings of each round are laid first with the daps up; then the top and bottom cribbings are laid with the daps down, so that each round of cribbing is separate from the next. If the cribbing is laid with all the daps up or all the daps down, each round is tied in with the next. The "picture-frame" form is used at Miami because that form is easier to repair and the cribbing is more easily kept on line and grade than if the rounds were tied together.

The practice of placing angles on the bottom cribbing and omitting them from the top cribbing tends to throw the bottom cribbing too far ahead and to make the pitch of the raise too steep. This is overcome by using a 2-in. plank occasionally as a shim between the top cribbings of two successive rounds. An oversize or undersize cribbing may throw the raise off grade or line and make a shim necessary. The cribbing may become twisted so that the side cribbing is not plumb and the top and bottom cribbing not level. This is corrected by twisting each new round, as it is put in, clockwise or counter-clockwise with reference to the round below until the error is corrected. Trouble from twisting is usually encountered in special raises where the main raise and branches are not in the same vertical plane. Timber junction sets, at the points where the branches join the main raises, did not stand up well under the battering of muck coming from two directions, so the steel junction set, made of 6-in. I-beams as shown in Fig. 3, was devised. It has proved satisfactory. These sets are reclaimed, along with the angles, and used again.

The Branch Raises

When the main raise has been connected with the grizzly level, the air lines and water lines from the pony set are removed and the raise below the lower junction is cleared of division boards and ladders. The branch raises are then driven by crews entering from the grizzly level. Timber and supplies are stored on the grizzly level, thus avoiding congestion on the haulage level, and are lowered down the main raise to the junctions, then hoisted with rope and snatch block up the branches. The lower part of the main raise is used for muck storage and is drawn only periodically. No division boards are used in the branches, and the two partners work together in one branch at a time.

Air and water hoses are attached to connections on the grizzly level. The 4-ft. winzes are sunk at the tops of the branches, as well as in the main raises. Whenever men are working in a transfer raise, whether in the main raise or branches, a sign, reading "Danger, Man Above," is hung in the pony set as a warning to passers-by in the haulage drift, and so that chute blasters will not, inadvertently, set off a "bomb" under the raise men. When men are working in the branches, a sign, reading "Danger, Man Below," is placed on the main raise grizzly. Grizzlies are placed over the raises as soon as they are holed through to the grizzly level.

Nuisances

The bane of the ore-train boss's existence is the transfer raise, in which the muck frequently hangs up and refuses to run. Obstruction may be caused by boulders becoming keyed together, or by wet, soft muck packing and building up on the bottom of the raise. The simplest remedy for such conditions is blasting. Several sticks of powder, two as a rule, are tied to the end of a blasting stick which is ten feet long and an inch square; an electric blasting cap is inserted in the powder and its lead wires are tied to the ends of a spool of blasting wire. The powder and blasting stick are then pushed up the raise, and the blasting wire is paid out until another blasting stick can be lashed to the end of the first. In this way the explosive is pushed on up the raise until it reaches the obstruction, which may be fifty feet or more above the level. The other two ends of the spool of blasting wire are then connected to the terminals of a Davis blaster, a small, hand-held blasting machine which is operated by spinning a magneto with a key.

Determining Crushed-Ore Moisture

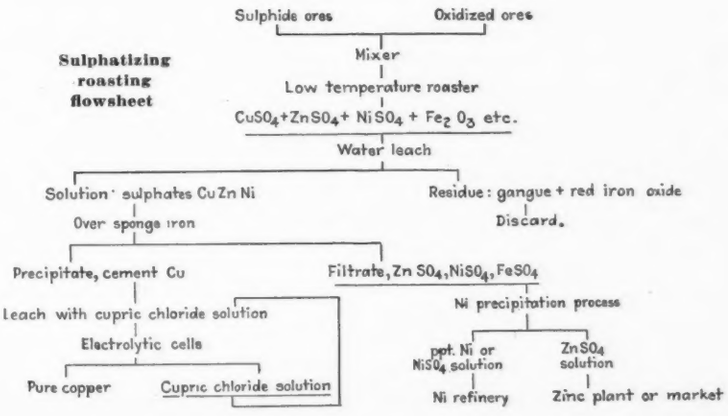
A METHOD of determining moisture content in aggregates used in construction work, recently reported by the Technical Advisory Committee of the Roads Department of the Ministry of Transport, London, is equally applicable for determining moisture in crushed ore that is not contaminated with a chemical that would react with the reagents used. The method involves the titration of a standard solution after it has been diluted by intimate contact with the material being tested. The solutions used are (1) a solution of sodium thiosulphate (hypo), 25 grams per liter, and (2) a deci-normal solution of iodine (25 grams potassium iodide and 12.7 grams iodine per liter). A 500-gram sample of the material to be tested is well shaken with 200 cc. of the standard hypo solution, and the resultant diluted solution is decanted into a burette and titrated against 25 cc. of the iodine solution, starch being used as an indicator.

Moisture content of the material may be calculated from the volume of hypo solution required for the titration before and after dilution by contact with the wet material, thus: if 500 grams of the material, containing x per cent water, is shaken with 200 cc. hypo solution, the latter will be diluted to total volume of $200 + 5x$ cc.; the ratio of the concentration of the hypo solution before dilution to that after dilution will be $(200 + 5x)/200$. Further, if a is the number of cubic centimeters of hypo (undiluted) required to neutralize a given volume of the standard iodine solution, and b the number of cubic centimeters required after dilution, the ratio of concentrations before and after dilution is b/a. Then, inasmuch as $(200 + 5x)/200 = b/a$, therefore $x = 40\ (b - a)/a$.

Sulphatizing Roasting

Edgar A. Ashcroft has written the Editor to point out that the abstract of his article entitled "Sulphatizing Roasting," which was published in the October issue of *Engineering and Mining Journal*, pages 420 and 421, was evidently prepared from one of the first, unrevised, advance copies of his paper. The flowsheet published on 421, according to Mr. Ashcroft, is at fault, and at his request the corrected flowsheet is presented herewith.

Sulphatizing roasting flowsheet



Silicosis Legislation

With Special Reference to Proposals in the State of New Jersey

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SILICOSIS is becoming a formidable economic burden in some industries and is at last coming into recognition in this country as an important industrial disease. The more hazardous trades will require a very profitable business to withstand the overhead involved in the heavy compensation expenses, or the costs and awards of lawsuits resulting from an awakened public consciousness that the fruits of industry must not be enjoyed at the expense of the health and safety of the labor which produces them.

From the Toronto *Evening Telegram* (Canada) comes the report that for every $5 expense in mining and concentrating a ton of gold ore $1 is required by the item of compensable cost for silicosis. But many industries other than mining and the contracting of rock excavations are seriously involved in this dust hazard. Without consideration of the great number of workers exposed to dust hazard contingent to the operations of other industries. the following specific industries deserve mention because of the number of wage earners therein employed who are subject to dust hazards, whether of silica dusts or the dusts of other minerals or metals:

1. Metal mining and milling
2. Non-metallic mining and milling
3. Excavation of rock
4. Coal mining and washing
5. Non-ferrous smelting
6. Ferrous smelting
7. Cement industry
8. Clay products industry, other than non-clay refractories
9. Non-ferrous metal alloys
10. Glass manufacture and optical
11. Iron and steel foundries, metal casting, and, chiefly, from sand-blasting castings
12. Pottery and porcelain ware
13. Granite, slate, marble, limestone, and other stone products
14. Mineral fertilizers
15. Cutlery
16. Asbestos products
17. Abrasives
18. Pulverized sand or other ground minerals and earths
19. Hones, whetstones, oilstones, grindstones, and similar products
20. Sand-lime brick
21. Cleaning and scouring powders or soaps
22. Rubber industry where pulverized mineral fillers are used

This is a supplementary article to the first of a series of articles on silicosis that appeared in the preceding issue.

The Silicosis "Racket"

Why advocate compensation laws in industry? Because when such laws are fairly, clearly, and intelligently drawn they give most necessary protection to both the worker and his employer from unscrupulous interests who prey upon both. The worker is seldom familiar with all of the hazards of his occupation unless they are specifically pointed out to him. He has a fear of the expense of time and money, and the uncertainty of results, from participation as a principal in lawsuits. His savings from wages can never compensate any incapacity and subsequent loss of earning power from industrial hazards, so he and his dependents are not provided for in case of such a misfortune contingent to industry; therefore he needs the protective interest of some well-informed and unbiased body politic.

The employer cannot be both a specialist in his own art and also qualify as a skilled pathologist and hygienist. He, too, needs guidance in the matter of vocational hazards as a result of expensive research beyond his means, and therefore dependent upon group activity or some public agency, in order that he may care for and protect his workers in a manner that any fair-minded employer desires. But without regulations and compensations prescribed by law he does not know what he should do and is left subject to disastrous monetary judgments in suits at common law from ill-informed or misinformed judges and juries who cannot be expected to learn in a few days the technical intricacies to which technical experts have devoted years of study, and which can be solved by them only after long periods of special experience. So without compensation laws the employer is subjected to the preying of "shyster" lawyers who exact from the worker a fee of usually one-third to one-half of the judgment granted to him and have even obtained as much as 80 per cent of the amount allotted. Usually there is no limit to the amount which can be recovered, but a few states have enacted a statutory limit on recoveries for death. The judgment at common law is in a lump sum and is final after the defendant has failed in his appeal to the court of last resort; and such a judgment is not subsequently subject to revision even though newly discovered evidence proves that the condition of the plaintiff was exaggerated at the trial.

Under most compensation acts the payments are made in installments, and even after the trial are subject to revision on the basis of additional evidence of the physical condition of the claimant, because the latter is still subservient to the powers of the compensation board. The employer, by the provision of liability insurance in accordance with compensation laws, can budget his vocational hazards and thereby avoid such uncertainties in his business, and he is taught the economic value of preventive measures and is justified in applying them.

Unscrupulous lawyers and doctors are deterred by compensation laws from preying upon both labor and capital.

Laws Needed for Self-Protection

We in the United States have been too slow to realize the social and economic need for placing the dust hazards in industry under the jurisdiction of compensation laws, and it is to our shame that we have waited until forced by the economic pressure of "racketeers" into a situation where we welcome such laws for our own self-protection. But the danger still exists that we may not yet see the need and justice for dealing with the matter broadly and conclusively rather than limiting our interest to the particular fields wherein our pocketbooks have been attacked. In the states of West Virginia, New Jersey, and New York, because of the lack of any compensation laws covering such dust hazards, the "racketeers" have recently made raids on the following industrial groups: tunnel contractors, sand pulverizers, the ceramic industry, and the foundries where sand-blasting is used.

Perhaps this is the reason why silicosis legislation is in the making in New Jersey, Wisconsin, Michigan, Pennsylvania, and New Hampshire, and tentative plans are being formulated for similar legislation in New York, Ohio, and Minnesota. It is noticeable, however, that the legislation proposed for New Jersey covers only a limited part of the general dust hazard, specifying the coverage of only the incapacity of an employee from a fibrous growth of tissue in his lung from the inhalation of a certain few inorganic dusts, such as free silica (quartz), asbestos, coal, and the "dust employed and/or generated in the process of cleaning, grinding and/or polishing metals."

That of the 44 states and four territories of the United States which possess workmen's compensation acts, none specifically mentions silicosis or other pneumoconioses (dust injuries to the lung), is no less than astounding. Five states and one territory (Illinois, Minnesota, New Jersey, New York, Ohio, and Puerto Rico) have scheduled certain occupational diseases as compensable but have not listed silicosis among them. *California, Connecticut,* the District of Columbia, Hawaii, *Massachusetts,* Missouri, North Dakota, the Philippine Islands, and *Wisconsin* permit the inclusion of occupational diseases under a possible interpretation of the general coverage "personal injuries arising out of employment," and in those states *italicized,* compensation awards for silicosis have been made, although in the last three of these the terms and conditions have not yet been definitely established. The following foreign countries have been more progressive than the United States has been in listing such dust diseases of the lungs as compensable: Argentina, Bolivia, Brazil, Chile, Mexico, Bulgaria, Czechoslovakia, Denmark, Germany, Sweden, Switzerland, Russia, U.S.S.R.); and in the British Empire, Australia, New South Wales, South Australia, West Australia, Queensland, New Zealand, Tasmania, Union of South Africa, England, and the Canadian provinces of Alberta, Ontario, and Saskatchewan.

Analysis of New Jersey Bill

Consideration of the bill to be submitted to the Legislature of New Jersey is timely not only because it is under consideration by the State's Dust Disease Commission, but also because any constructive criticism of it may have a value to other states in which similar legislation is being considered. The breadth and effectiveness of any such act would seem to depend upon two main factors, the qualifications of the men who formulate it, and, similarly, the nature of the body originated under the act to interpret and supervise its application.

Without intent to criticise the eminence and public spirit of the drawers of the New Jersey bill, it may yet be fair to question whether the group is sufficiently representative of the experiences so valuable in the analysis of all of the conditions which should be covered. A Dust Disease Commission of nine members was formed by three appointments made by each of the following agencies: The Governor of New Jersey, the President of the New Jersey Senate, and the Speaker of the New Jersey Assembly. Then the commission elected a tenth person as its secretary. The personnel of this commission represents the following vocations: three lawyers, three doctors, a representative of organized labor, an industrialist, and a college professor of ceramics. A fourth lawyer was appointed secretary of the commission.

All interested in the subject here under discussion should bear in mind the fact that the problems of dust diseases of the lungs (including silicosis) have occupied the attention of many noted doctors and pathologists for thirty years without definitely satisfactory conclusions in regard to diagnosis, causes, cures, and prevention. The subject is, therefore, not one in which most physicians and lawyers are well informed either from study, personal experience, or technical training.

Their Knowledge Limited

Many factors are present which surpass their knowledge of roentgenology, biology, chemistry, mineralogy, and engineering, or other technical methods and appliances. That the proposed bill specifies that it applies only to an inorganic dust, and later includes in that specification such a dust as coal, which is of vegetable origin, is therefore not surprising. Again, the bill is limited to consideration of the few mineral dusts such as quartz, asbestos, and an uncertain dust which produces "siderosis" where any such dust is "employed and/or generated" in the specifically limited "processes of cleaning, grinding and/or polishing metals." This word siderosis is derived from the Greek word "sideros," meaning iron, and the dictionary defines the medical term siderosis as meaning, "a sort of pneumonia occurring in iron workers, produced by the inhalation of particles of iron." Surely the commission's definition does not seem apt. The commonly accepted generic term "pneumoconiosis" is not given a place in this bill, although it represents and describes all types of lung diseases resulting from the habitual inhalation of either mineral or metallic dusts, and is derived from two Greek words, "pneumon," lung (plural "pneumones"), and "konia," dust.

When we also note that the only injury to the lungs which could be given consideration under this bill is "the substitution of fibrous tissue for elastic tissue of the lung," "caused by the inhalation of inorganic dust during the course of employment," a most circumscribed field of application is plainly seen to be intended, and its protection of the worker is apparently unduly limited, and the proposed act thus becomes unworthy of the title which it bears.

Non-siliceous and Toxic Dusts

Competent evidence and authority are available to warrant the belief that minerals other than quartz have an equal or a greater influence in producing the disastrous and fatal pathological conditions of the lungs, including fibrosis, which have been ascribed to silica (quartz). Some silicate minerals, particularly the fibrous silicates of alumina such as sericite, sillimanite, and tremolite, also pumice, fall in the above category. A relatively new name, "silicatosis," has been coined to distinguish the dust injury to the lungs by the silicate minerals from that due to free silica (as from quartz, flint, or diatomaceous earth), which is now called "silicosis."

Additional dust hazards are, however, present in other minerals (and chemical compounds) which may be non-siliceous but are formed from other metals, which have toxic (poisonous) properties, such as lead, arsenic, and manganese. The new name "pneumonotoxiconiosis" is proposed to cover the injuries resulting from these, although the diseases may not affect the condition of the lungs. Surely, in preparing a Dust Act to protect the worker, we should wish to include all of the known hazards of various dusts, and should word it broadly enough to permit the inclusion under its regulations of mineral or chemical dusts which are subsequently found to cause a vocational hazard.

The term "anthracosis" is defined in the bill as "a dust disease in which the injurious agent is coal dust." Minerals associated with coal may give rise to mixed dust. There is good reason to believe that the silica or silicates often present with coal are important factors in the injuries sustained from breathing the dust in coal mines and coal breakers. Presumably, injury from such associated minerals would be recognized as silicosis or silicatosis.

Although the inhalation of any of the dusts of the scheduled dust diseases does not assure that such a disease will result, enough references occur in literature to support the scheduling of such diseases as possible compensable vocational hazards. The determination of fact should in each individual case be the responsibility of the Board of Control.

Personnel of Administrative Body

But who are the Board of Control? The proposed New Jersey bill specifies that a Medical Board shall be created by the Compensation Rating and In-

spection Bureau of New Jersey under the supervision of the Commissioner of Banking and Insurance, and that it shall be composed of three members who have acquired "by special study or experience, or both, special knowledge of scheduled dust diseases." At least two of the members must be "physicians admitted to practice medicine in this State" "and the third may be such physician, or a chemist, or a roentgenologist." The functions of such a board are, to aid "in improving working conditions by preventing and controlling scheduled dust disease hazards"; to assist in determining "the hazard of individual risks due to scheduled dust diseases"; "to cooperate and advise in measures calculated to prevent and control scheduled dust diseases in industry"; and to cooperate "in determination of liability and compensation in all matters of scheduled dust disease."

Because prevention of dust hazards is the most important function of the Board of Control, for the benefit of society, it would seem desirable that one member of the board be an engineer with executive experience in industry who possessed practical knowledge and experience with methods and equipment for the prevention of the hazard, and an understanding of working conditions and requirements so necessary to the promulgation of sane and practical regulations, and of the methods of determination of the amount of disability in earning capacity of a workman. The services of a mineralogist, petrologist, or ventilation expert might be very valuable on such a board and might well be covered by the term "other technologist."

A Board of Control

Therefore the proposal has been advanced that the board be comprised of one medical man, one engineer, and one chemist or other technologist. For the reason that it is not, strictly, a medical board, the suggestion is made that it be named the Board of Control. Those principally concerned with the proposed legislation may well note the fact that in South Africa, where more attention has been given to the silicosis problem during the past thirty years than in any other country in the world, the findings of a medical board have quite recently been qualified by the work of a petrologist from Great Britain, Dr. W. R. Jones, who presents strong evidence that the mineral sericite (hydrous potassium aluminum *silicate*) has been more responsible in promoting the so-called silicosis in that country and elsewhere than has the *free silica* generally held responsible and solely specified in the New Jersey bill.

Furthermore, this bill seems very narrow in its protection of both employer and worker, for the reason that it covers only that pathology resulting from "the substitution of fibrous tissue for elastic tissue of the lung," and "inorganic dust," for coal is of organic origin, and cotton and hair dusts also produce vocational disabilities. A broader term than "inorganic" would be *non-viable*, and the latter name would exclude bacteria and protozoa (microscopic vegetable and animal organisms, respectively).

Some of the Provisions

Paragraph *22*(k) of this bill places the compensation liability upon the employer whose employee was "last injuriously exposed to the dust described as the injurious agent." Since the injuries from such dusts are cumulative, and often over a long period of time during which transfers of employment are usual, although in similar vocations and hazards, an unfair economic burden is thereby placed on the last employer unless he can, under amended terms of this bill, collect a proper share from former employers who have contributed to the disability, in accordance with the joint responsibility of employers under the laws in Australia, or the joint responsibility of employers during the five years preceding the date of injury, as in Great Britain.

Paragraph *22*(i) states that the disability must have "commenced within two years after the termination of such exposure," and paragraph *22*(m and n) requires that the employee must give notice of his claim "within a period of two years after the date when said employee shall have ceased to be subject to exposure." Such diseases are insidious and progressive after removal from the exposure, and whether such terms give proper protection to the workman is questionable. To require the claim to be made within a certain period (say two years) after the employee has learned of his impairment because of exposure to the dust hazard would seem fairer, provided that a period of, say, not more than five years has elapsed since the employee's last exposure.

Paragraph *22*(o) requires that the employee must have been exposed to the injurious dust in the State of New Jersey "for a total period of at least two years." A member of the New Jersey Rehabilitation Commission is quoted as reporting six fatal cases of silicosis from silica grinding following a claimed exposure to silica dust lasting from four to eighteen months, and therefore, to reduce the required period of exposure to one year or less would seem reasonable. The act also states that no part of the said total period shall antedate the enactment of the Dust Disease Act (1934). Such a provision is debatable, in all fairness to employee and employer, and might well be omitted and left to the discretion of the Board of Control if definite responsibility can be fixed. Though to hold the employer responsible for his possible ignorance may seem unfair, lack of knowledge does not excuse him for permitting the presence of accident hazards, and the danger of certain dusts (silica, for example) has been recognized by the well informed for thirty years or more.

Paragraph *27* gives the Board of Control the right of a post-mortem examination under a death claim. For the public good this paragraph might well be extended to grant such right in all cases receiving compensation under this Dust Disease Act, for only in this way can the medical aspects be vigorously advanced and X-ray and other methods of diagnosis correlated and proved. Considerable expense will be involved in clinical and X-ray examinations of claimants, and the State should profit by the ultimate follow-up.

The proposed act might well be extended by adding an article under Section 12. Such an article should deal with the proposal that all employees, in order to qualify as applicants for awards under the compensation act, should have given their employers an opportunity to make physical and X-ray examinations of the claimants both at the time they apply for employment and also when their employment terminates. A copy of the medical findings should be given to the employee and also recorded with an assigned state agency. The intent of such a paragraph is obviously to protect both employer and employee. The X-ray record of an employee's lung condition upon termination of his employment will give him knowledge of his physical condition and any impairment which might have resulted from his vocation, and will also protect the employer from wrongly conceived compensation claims; and the State Compensation Bureau will accumulate vital evidence to aid in its findings.

The commission wisely avoided the inclusion of any codes in its proposed New Jersey Dust Disease Act, for knowledge of the causation of silicosis and kindred diseases is still too indefinite and contradictory, and any code formulated today might quickly be made obsolete by new technical researches. Silica itself may not be the chief offender, and the present methods of dust sampling and the quantitative determinations of the dust content of respired air, whether by weight or count, may be superseded by new methods, which include smaller particles than ½ micron and which emphasize the form factor of dust particles and other physical and chemical properties of dusts. The assumed relationship of particular dust content to percentage of free silica in the dust as scheduled in proposed laws of the states of Michigan and Massachusettes may soon be proved unsound, and the distinction between dust-count groups may well be condemned as impractical, as the statutes of these states assume a greater accuracy in such determinations than the limit of error and human equation in making such dust counts.

Examining a Placer By Geophysical Methods

A Specific Case In Trinity County, California

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GEOPHYSICAL PROSPECTING is of special interest today because of the present expanded activity in gold mining. Activity implies the examination of prospects as well as development of properties having production records. Geophysics is of especial value in the initial evaluation of a prospect, because by it additional information regarding subsurface conditions can be obtained before purchasing or opening a property.

In considering geophysical work for placer deposits, one must bear in mind that no geophysical method can locate gold directly, in the normal concentrations usually found in placer or lode deposits. But in the majority of such occurrences concentrations of "black sands" (magnetite, ilmenite) are found to be intimately associated with placer gold concentrations, and this has provided an indirect method for locating the gold. When sufficiently well marked, and under other favorable conditions, these "black-sand" concentrations can be located by magnetic methods. My experience shows that magnetic methods are capable of a unique interpretation only when simple conditions prevail in the area. When the bedrock and basement complex have fairly uniform magnetic properties, the magnetic studies will usually show the main concentrations of placer materials by magnetic "highs" superimposed over the regional gradient established by the underlying rocks.

Such simple conditions do not usually exist, owing, in the main, to the following factors: (1) Lack of well-defined concentrations of placer materials, with general horizontal distribution over the bedrock. (2) Variations in thickness of gravels caused by surface erosion (which can be seen) and irregular bedrock contour (which cannot be seen). (3) Variations in the magnetic properties of the rocks underlying the placer, caused by structural variations in the bedrock and the basement complex. Most of these factors cannot be properly evaluated or recognized by geological and magnetic studies alone, so that much supplementary work must frequently be done. We have found that certain electrical methods furnish a reliable and rapid means of determining: (1) thickness of gravels and contour of the underlying bedrock; (2) important structural features in the bedrock, with reference to faults and dikes; and (3) subsurface distribution of water.

Field procedure for the solution of the more complicated and most prevalent type of placer problems is usually divided into the following principal steps: (1) Geological and topographic survey of the area. (2) Magnetic survey of the area. (3) Electrical studies at the most important points (as indi-

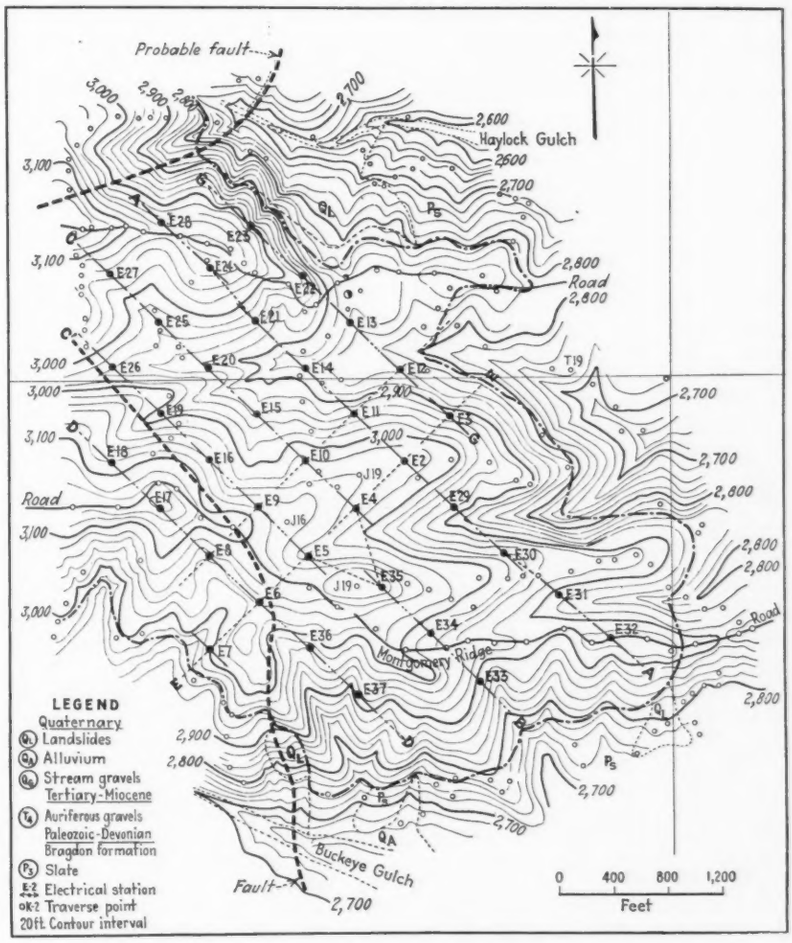


Fig. 1—Map of placer area, in Trinity County, Calif., surveyed by geophysical methods. Lateral extent of gravels, areal geology and topography are shown

Excerpted from T.P., 515, A.I.M.E., to be presented at the New York Meeting, Feb. 19-22, 1934.

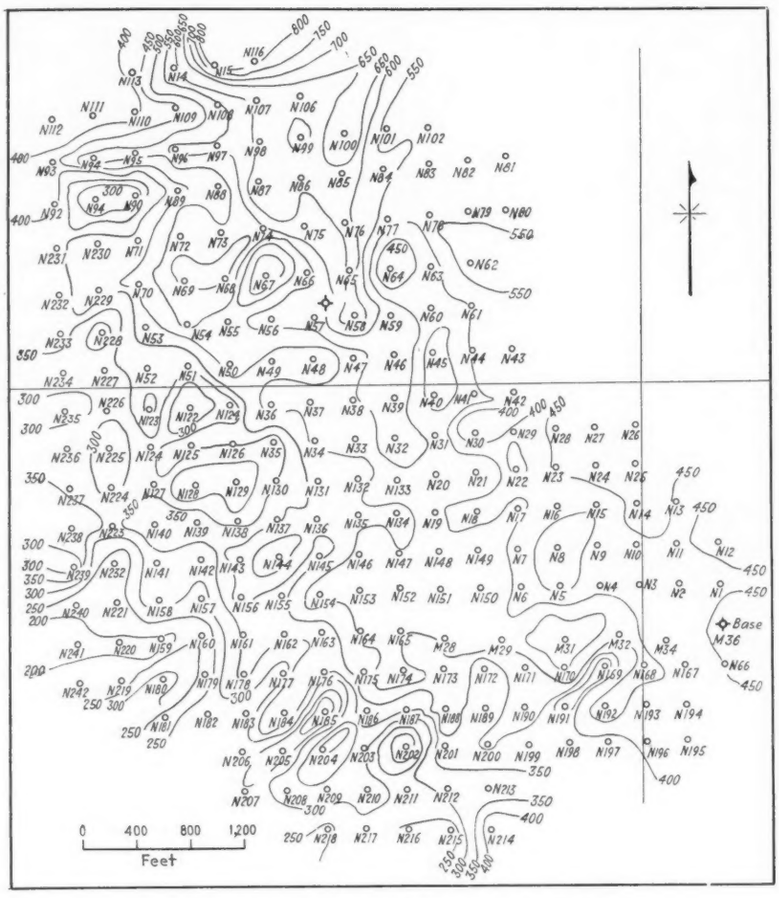


Fig. 2—Magnetic contours for area shown in Fig. 1

cated by geological and magnetic work), to obtain thickness of gravels and depth to bedrock, from which are made calculations giving tonnage of gravel available for mining, cross-sections showing bedrock profiles, and bedrock contours.

This work may be illustrated by a survey conducted in Trinity County, Calif. The property consisted of several thousand acres of gravels which, on the surface and in occasional test pits, panned uniformly in gold. The problem was to select, by a geological study and preliminary geophysical work, what part of the total acreage should first be developed, and then, by detailed geological and geophysical work on that restricted acreage, outline the gravels, give their depth, the contour of bedrock and attitude of bedrock surface, and, if possible, locate the likely areas for gold concentration as indicated by any "black-sand" concentrations found. As a result of the survey, recommendations for further development and exploration were to be made.

After careful reconnaissance of the whole property, between 500 and 600 acres were selected for detailed work. The lateral extent of the gravels, the areal geology, and the topography of this area were first determined and plotted in detail, as shown in Fig. 1.

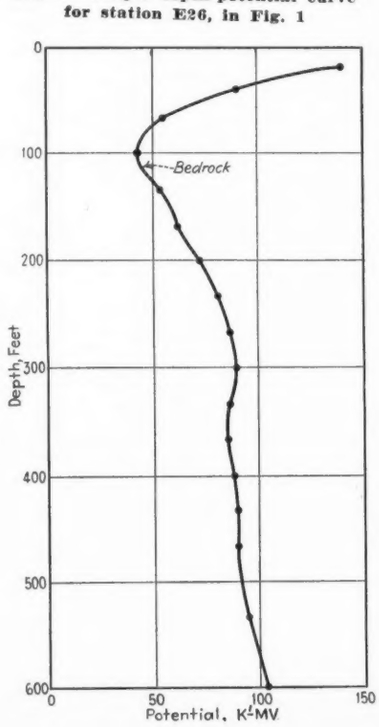
Magnetic measurements of the vertical intensity were made at 242 stations over the area, at intervals from 300 to 400 ft. The intensity was read for each station, and after corrections for diurnal, temperature, and latitude variations, the magnetic values were plotted in the form of magnetic contours. These contours are isodynamic—that is, lines of equal anomaly in magnetic vertical intensity—and are shown in Fig. 2. This map shows the actual magnetic field anomalies before corrections were made for local gradient and the topographic effects in the gravel surface and the bedrock surface. As can be seen, a study of the geological and magnetic maps did not allow a unique interpretation either as regards major concentration zones of the "black sands" or of bedrock conditions. The magnetic and geological work had therefore to be supplemented with electrical studies.

In the electrical work a current of known value is passed into the ground through two electrodes placed at varying distances apart. The resistance, which governs the subsurface distribution of the current, depends mainly upon the amount and character of moisture present. Inasmuch as the amount of moisture will depend upon the porosity, one can see that the regulating factors governing the rock resistivities are the nature of the electrolyte (ground water) and the degree of consolidation or induration of the rock material. Well-indurated rocks, such as shales, slates, and sandstones, will in general have higher resistivities than more loosely consolidated gravels and more recent fill material.

Electrical measurements were made at 37 stations distributed at regular intervals. Proper spacing of stations is a matter of experience and is governed by the local geologic and topographic conditions. In this instance the stations were arranged in lines in a northeast-southwest direction at 600-ft. intervals, over most of the area. In the southwestern portion they were placed at 800-ft. intervals, as location of the gravel contact was known on three sides from the surface evidence, and closer spacing was unnecessary. After mathematical calculations, the electrical readings were plotted graphically. From each station a main curve was plotted showing the variation in current distribution with depth, and two auxiliary curves were also plotted, showing separate variations in two or more directions from the station, for evaluating topographic and near-surface effects.

All electrical curves showed the potential variation from the surface to a depth of 600 ft. at suitable depth intervals. Because of the difference in resistivity between the gravels and the more compact rock types, such as the bedrock, the boundary or contact between the two materials at depth is indicated on the curves by an increase, or upward trend, caused by the increased resistivity of the bedrock. The shape and slopes of the curves indicate changes in subsurface electrical conditions. These changes are then interpreted in terms of changes in subsurface structure. From these

Fig. 3—Simple depth-potential curve for station E26, in Fig. 1



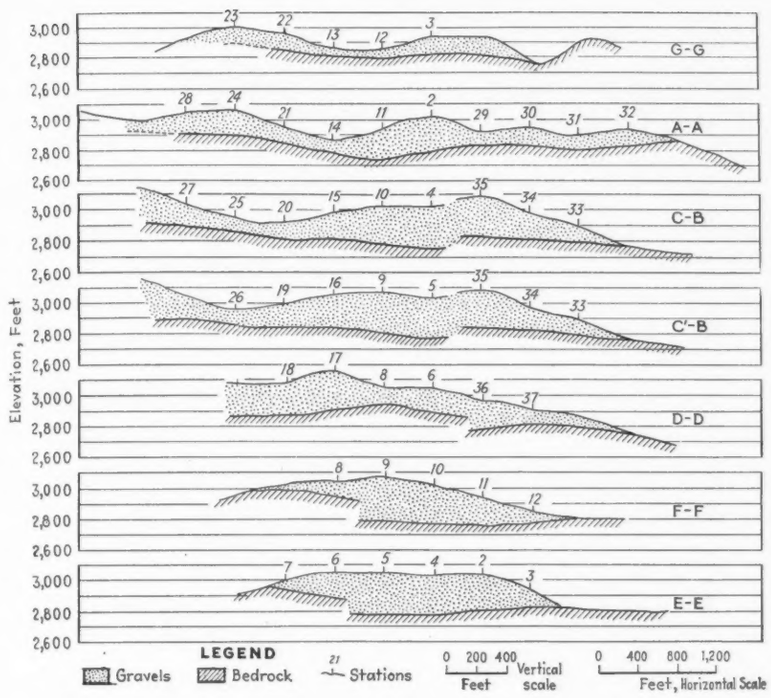


Fig. 4—Results of complete electrical survey, as expressed in cross-sections of the deposit along the lines of the survey

curves the depth to bedrock at each station was determined. Correlation of these depths to the trace, on the surface, of the gravel-bedrock contact, and the surface elevation shown by the topographic survey, provided data for plotting subsurface bedrock contours. The contours were then plotted. The depth to bedrock as given by the electrical work is an average or effective depth over an area having dimensions comparable to the depth of penetration. On this property, the maximum thickness of gravels was about 300 ft.

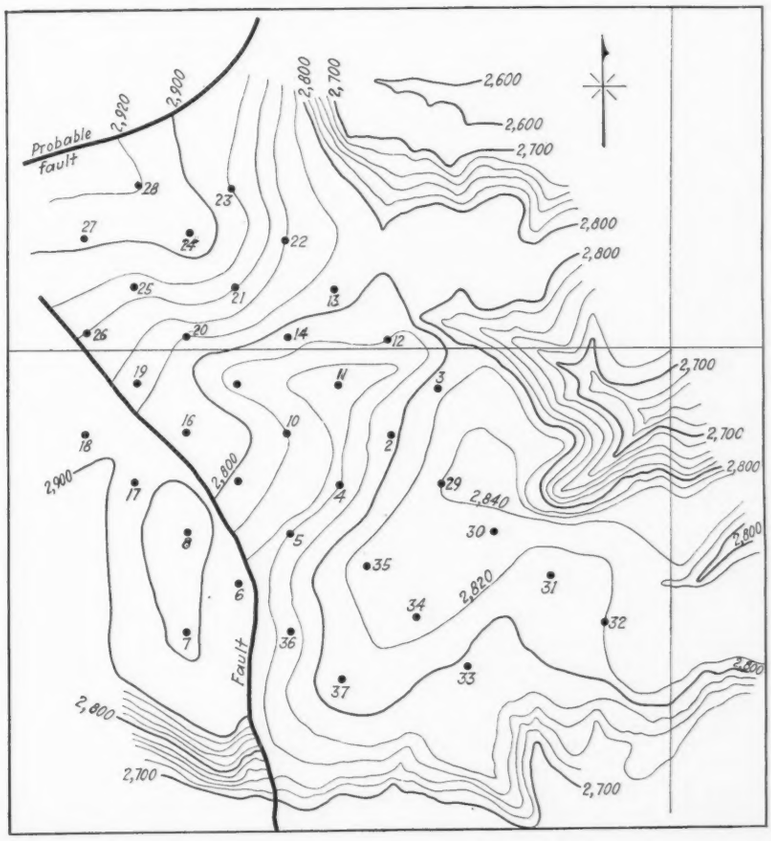
As an illustration, the simple depth-potential curve for station E-26 is shown in Fig. 3, and may be selected as showing the characteristic variation in the area. The curve shows decreasing values from the surface to a depth of 100 ft., corresponding to increased moisture in the gravels with depth. At 100 ft., the values start to increase again, indicating the presence of the more resistant bedrock below. Final calculations gave the depth to bedrock at 110 ft. On this curve the changes are easily recognized, but on some curves differentiation is more difficult because of the complicating factors of topographic effect, and local portions of the bedrock that are more conductive than the bedrock as a whole.

Results of the complete electrical survey are shown most plainly in Fig. 4, giving cross-sections of the deposit along the lines of the survey. From these sections the approximate total yardage of gravels, in the area examined, may be obtained. A striking feature of these sections is the evidence of faulting in the bedrock, as shown on section D-D, F-F,′ and E-E,′ where the electrical survey indicated an escarpment in the bedrock of more than 100 ft. average vertical displacement. Previously, this had been unsuspected, as the trace of the fault was covered by fill material over practically the whole property. After discovery of the fault by geophysical methods, its trace was found in a gulch at one point where erosion had slightly exposed it. As can easily be seen, the knowledge of this escarpment materially affected plans for hydraulic mining. The bedrock contours are shown complete in Fig. 5.

Before the geophysical survey was made, the mining company had perfected plans for beginning hydraulic operations in the northeast part of the area, because surface topography indicated that the bedrock most likely sloped toward this gulch. When the results of the geophysical work were known, the operations at that point were abandoned, as not being at the proper place for economical development, and plans were made for immediate work in the southern part of the area.

In general, the bedrock surface slopes toward the southeast. The most uniform portion of the surface is to be found just east of the buried main fault. The natural slope of the bedrock and the long fault escarpment make conditions favorable for hydraulic mining operations to start at a suitable point in the southern part of the area and to the east of the buried fault. Bedrock contours indicated that some bedrock cuts would have to be made to provide proper drainage, but that these would

Fig. 5—Contours of bedrock on area surveyed



be of a minor nature. The magnetic work, in conjunction with the later electrical work, indicated a fairly flat but locally irregular bedrock surface. No strong local concentrations of magnetic minerals were indicated, though the magnetic anomalies, interpreted in the light of the electrical results and regional gradient, show slight concentrations along the trough of the fault. Exploration shafts and trenches indicate that the gravels are fairly uniform in composition and also present evidence that some gold concentrations will occur at, or near, the bedrock surface.

The complete geological, topographic, magnetic, and electrical survey required about one month and was made at a cost of approximately $3.30 per acre, exclusive of the living expenses of the crew.

The work at Meteor Crater, in Arizona (described in *E.&M.J.*, July, 1932), is another illustration of the combined use of the magnetic and electrical methods described in this paper.

Magnetic equipment for this work is the conventional Schmidt-type field balance. The theory, operation, and construction of this and similar magnetic equipment have already been described in technical literature.

The electrical equipment is of two general types: (1) for measuring electromagnetic field strength; and (2) for measuring surface potentials. In each a known current is passed into the ground between two electrodes.

In the magnetic field-strength system, current from a special power supply is passed into the ground between two electrodes. The subsurface distribution of current is obtained by measuring the field strength, associated with the flow of current, at various points on the surface of the ground. Curves are plotted showing the relationship between magnetic field strength and depth. Knowing the theoretical factors governing the distribution of current, inflections in these curves are translated into subsurface geology. By use of this direct method—that is, the direct measurement of the field associated with the flow of current, instead of the potential between two auxiliary electrodes on the surface of the ground—topographic and near-surface electrical inhomogeneities are minimized, with a decided improvement in accuracy and reliability.

Erroneous results introduced by use of alternating current (such as skin effect, phase shifts, and induction effects) are eliminated in this method by employment of a unidirectional current for energizing the ground.

A surface potential method in which two auxiliary electrodes, having a fixed spacial relationship with the two power electrodes, are employed, is used under conditions of special adaptibility and to obtain data with which to supplement certain measurements of the electromagnetic field-strength system. Knowing the current flowing between the two power electrodes, and the resultant potential existing between the two auxiliary electrodes, one can make calculations which give the effective resistivity of the total subsurface included in the measurements.

Colorado Camps Active

Cripple Creek Revived—Leadville, Alma, and Breckenridge Busy

John B. Huttl

Assistant Editor

EARLY IN JANUARY I visited Cripple Creek, Leadville, Climax, and various mining camps in the Alma, Boulder, and Clear Creek districts of Colorado. A visitor to these areas cannot fail to note a gradual renewal of mining activities and absence of gloom. Just as a new strike in an old mine, or the discovery of a new one, changes the settled atmosphere characteristic of old-established camps, so has the enhanced price for gold and silver brought new hope and inspiration to prospectors, miners, and capitalists of Colorado. Although one cannot talk of "boom" conditions—all activities are being conducted on a conservative scale—the indications are that conditions will improve still more with the advent of favorable weather and the solving of monetary matters.

In the Cripple Creek area mining activities have revived notably, as demonstrated by the development work under way on many old properties, by the erection of new plants and the rehabilitation of old ones, and the active exploitation of new properties.

Perhaps the outstanding change of ownership of recent years is the purchase of the Granite Gold holdings by the International Gold Mining Corporation, of New York. The ground acquired totals 130 acres and includes the Ajax, Dillon, Gold Coin, Dead Pine, Granite, and Monument properties. The major objective at present is the completion of the 8x7-ft. tunnel connecting the 2,000-ft. level of the Ajax and the 2,100-ft., or Roosevelt tunnel, level of the Portland. When this is done the company will sink a shaft to explore ground below the present workings. Pumps are to be installed on the 2,000-ft. level. Besides the 175 men employed, the company has leasers at work in the various properties. About nine cars of ore are being shipped weekly to the Golden Cycle mill, at Colorado Springs. C. W. Van Law is managing director.

Mill of Climax Molybdenum Company at Climax, Colo.

Portland Gold Mining Company, operating the Portland, Last Dollar, and Independence properties, produced about 26,600 tons of ore averaging $9.50 a ton in 1933. No company work is now being done, but all of the mines are being operated under the split-check leasing system. About twenty groups of leasers are resorting and screening the dumps.

The properties of the United Gold Mines Company, covering about 700 acres and comprising the Wild Horse, Vindicator, Golden Cycle, Deadwood, Pauper, Bonanza, and others, produced a total of 67,000 tons of ore of an estimated average value of $7.30 per ton during 1933. Besides this, about 14,000 ft. of development work has been done by the company and leasers. The mines are operated largely under a leasing system based on graded royalties ac-

cording to the value of the shipments.

The group known as the Stratton Estate, one of the largest units in the district, has had a year of better than average results. All of the Bull Hill ground has been taken, and many mines, such as the Abe Lincoln, American Eagles, and John A. Logan, are producing. Other Stratton properties under lease include the Geneva, Little Womack, Proper, Colorado King, Summit, Moon Anchor, Orpha May, Longfellows, and Sacramento.

On Guyot Hill the Unity Gold Corporation is operating the Katinka group of claims covering about 30 acres. The enterprise is sponsored by the North Butte Mining Company, of Montana, which has retimbered the shaft and installed hoisting and compressor equipment.

The famous old Cresson mine is still in operation and offers promise for the future. All work is now confined to the upper levels, inasmuch as mining below the 1,700-ft., or Roosevelt tunnel, level was found unprofitable because of the presence of water. Exploitation of the lower levels will be possible if the proposed drainage tunnel becomes a fact.

Aside from the activities mentioned, many companies and individuals are exploring the outlying districts. Cameron Gold has sunk a 500-ft. shaft near the old town of Cameron and opened three levels. Many unemployed are reworking and screening old dumps, and ingenious contraptions have been rigged up to scrape the rock into cars for shipment to Colorado Springs. All Cripple Creek ore is shipped over the Midland Terminal Railway to the Golden Cycle mill, at Colorado Springs, which is treating about 1,200 tons of ore a day. During 1933 the mill treated 362,473 tons of ore averaging $9.28, with a total bullion output of $3,366,228.12, as compared with 319,106 tons averaging $7.34, and bullion valued at $2,345,425, in 1932. The increase, of course, is due largely to the enhanced price of gold.

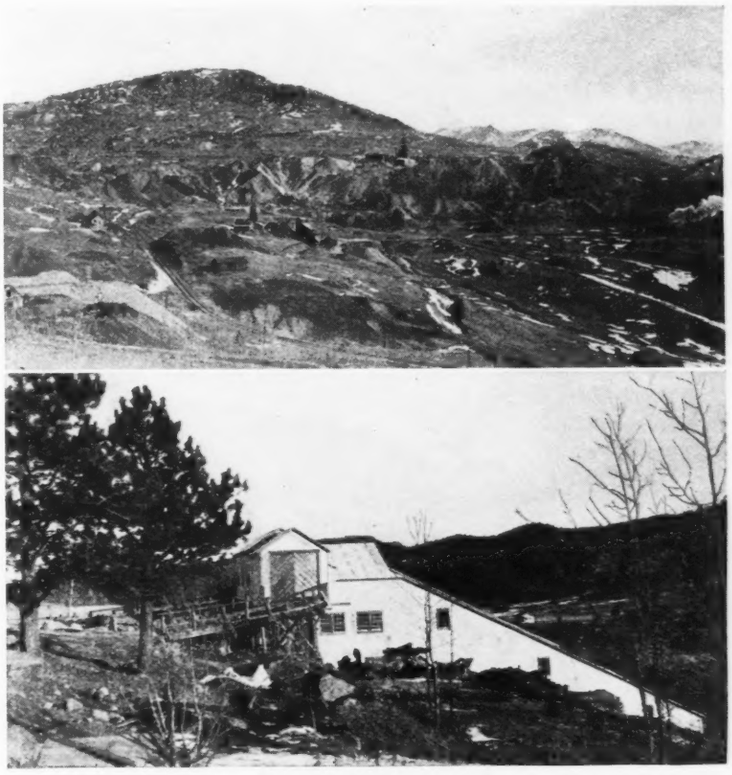
In the Alma district, mining activities have increased greatly. In Mosquito Gulch, London Gold Mines, Amer Mining Company, and Fairplay Gold Mines, Inc., are operating steadily. Newer enterprises include the London-Butte, West London Mines, and London Mountain Gold Mines.

London Gold Mines is milling 125 tons of ore a day assaying $18 to $20 a ton (gold at $34.06). The mine is opened by a 4,300-ft. tunnel known as the London Extension tunnel, and the crushing and sorting plant is connected with the mill by a 700-ft. jig-back tram. Ore is mined by a semi-shrinkage system. At the sorting plant it is washed, screened, and sorted. High-grade ore is shipped to Leadville or Colorado Springs, and milling ore is crushed to minus 1 in. in a jaw crusher and Symons cone crusher prior to being conveyed to the 100-ton rope-tramway bin.

Flowsheets of the London, Amer, and Fairplay mills vary but little. At the London mill, for instance, the ore is fed automatically to a Marcy ball mill equipped with a 10-mesh revolving discharge screen. The screen undersize, a minus 12-mesh product, passes first to a Fahrenwald Sub A unit cell and then to a Wilfley table. Screen oversize and table tailings are elevated to a Dorr classifier. From here the minus 65 mesh overflow passes to a 10-cell M. S. flotation machine, and the classifier sands are returned to the ball mill. Flotation concentrates are dewatered and thickened in a Dorr thickener and a Dorr filter. Reagents used are Pentasol xanthate, pine oil, and ordinary fuel oil. The latter is necessary because of carbonaceous matter in the sulphide quartz ore. The 100-ton Amer mill does not contain a Fahrenwald Sub A unit cell, but has two Wilfley tables. Recovery is better than 95 per cent. Ratio of concentration at the London mill is about 11 to 1. At the Fairplay mill about 60 tons of ore is treated daily. Recovery is 93.1 per cent, and ratio of concentration is 7.12 to 1. The heads assay 0.6521 oz. in gold. Pine oil, water gas tar, and ethyl xanthate are used as reagents. Concentrates are shipped to the Arkansas Valley smelter at Leadville.

An aërial tram 3,300 ft. long connects the Fairplay mine with the mill. The mine is equipped with modern air-generating, tramming, and drill-sharpening machinery. London Gold Mines is doing from 400 to 1,200 ft. of development and exploration work per month, besides about 900 ft. of diamond drilling. Over 290 men are employed at the three properties. Other plants in the district are the Summit and Paris mills, in Buckskin Gulch; the mill of Alma Syndicate on Mt. Bross; and the Magnolia, which is situated in Montgomery Gulch.

In the well-known Breckenridge placer area two dredges are at work. Tiger Placers Company, a subsidiary of Royal Tiger Mines Company, is dredging the ground at Breckenridge acquired from the Tonopah Placers Company in 1926. The dredge has been rebuilt and is equipped with 85 9½-cu.ft. buckets. Capacity is 5,000 cu.yd. a day at a power consumption of 500 hp. Another active machine is that of the Continental Dredging Company, which is also of the continuous-bucket-line type, with 96 7½-cu.ft. buckets on the digging line. Capacity is about 4,000 cu. yd. a day. Power consumption is 120,000 kw.-hr. per month, at a cost of 1½c. per kilowatt-hour. At the present price of gold ($34.06) the recovery is between 12 and 20c. per cubic yard.



Above—A distant view at Cripple Creek. Below—Mill of Wolf Tongue Mining Company, at Nederland, Colo.

At Leadville, the Arkansas Valley smelter of the American Smelting & Refining Company is treating 4,700 tons of ore a month with one furnace in operation. To insure continuous operations, the tonnage received would have to be increased to about 5,700 tons. The old Ibex mine is worked under a leasing system. Production is 800 tons a month. Tribune, Venir, New Monarch, and others ship about 700 tons a month, mostly dump material. About 2,000 tons of ore are received from the Alma and San Juan regions. The Gilpin district provides 700 tons of ore a month. In the Yak tunnel about twelve men are employed steadily. Increased activity is expected with the coming of spring.

Above—Washing and sorting plant of London Gold Mines, near Alma, Colo. Below—Argo mill at Idaho Springs, now operated by Galli Milling Company

Leaving Leadville, one's next objective is Climax. Here the Climax Molybdenum Company is mining and milling about 4,000 tons of ore a day. At the crushing plant two new Symons short-cone crushers have been installed, and at the old mill two mechanical flotation machines have been added. The flowsheet of the remodeled crushing plant is as follows: From the storage bin the ore is fed by a Ross feeder to a 48x60-in. Buchanan crusher which discharges the 8-in. product upon a 12x48-in. pan conveyor feeding to a 7-ft. Symons cone crusher. The material crushed to 2½ in. goes via a 36-in. conveyor belt to a 100-ton surge bin. The ore is next passed over four 4x6-ft. Traylor vibrating screens, the minus ⅜-in. undersize going direct to the mill bins, and the oversize passing to the two Symons short-head cone crushers which discharge upon the main conveyor leading to the mill bins. At the mill the ore is ground by six Marcy ball mills operating in closed circuit with Dorr classifiers, the overflow of which is treated by a series of Hebbard flotation machines. Reagent consumption is 0.25 lb. of Middol and 0.025 lb. of NaCN per ton of ore treated. Finished concentrates pass to a 16-ft. Burchart thickener, thence to a 5x8-ft. Oliver filter and a 12x28-ft. Lowden dryer. At the packing plant an Allis-Chalmers packing machine is used.

In the Clear Creek area, small-scale operations are in progress at five properties, the Galli Milling Company, Alma-Lincoln, Mattie Consolidated Mining, Engineers Mining, and Freeland Tunnel Transportation Company. The Galli has leased the Argo mill, at Idaho Springs, and is treating custom ores, mill capacity being about 150 tons of ore a day. Mattie Consolidated is operating its mine in Chicago Creek and has built a 50-ton flotation mill. Near Idaho Springs, Alma-Lincoln Mining Company has completed a 50-ton mill in which ore from the Barbara-Elliott mine is treated. A new ore-washing plant has been built by the Engineers Mining Company. The company is working the Belman vein through the Big Five tunnel and is shipping the washed ore to the Argo mill. Freeland Tunnel Transportation Company, controlled by the Lehman interests, of New York, employs twelve men on rehabilitation. At Georgetown, the Centennial mill is being reconditioned.

Consolidated Smelting & Metals Corporation, operating the Watrous mill, near Silver Plume, is milling about 100 tons of ore a day.

At Nederland, in Boulder County, early resumption of tungsten mining is anticipated. Wolf Tongue Mining Company has 40 leasers at its various properties, and is drilling its ground. The company has agreed to buy ore from leasers on a basis of $12 per unit of 60 per cent WO_3. The modern 25-ton mill is operated spasmodically. About 100 tons of tungsten concentrates is available for marketing. In Left Hand Canyon, the 75-ton Hadsel mill of the Slide Mines, Inc., is nearing completion. The company is doing considerable development work at its mine and employs 30 men. St. Joe Mining & Milling Company is operating fifteen stamps at its custom mill in the canyon. The mill contains a Fahrenwald Sub A unit cell, a Marcy ball mill operating in closed circuit with a Dorr classifier, a ten-cell flotation machine, and an American filter. Mill capacity at this plant is to be increased to 150 tons.

In the Ward, Wall Street and Salina districts, numerous small properties are operated by leasers, and several small mills have been reconditioned and placed in operation recently.

Change House at Desloge Pleases Men

The Desloge Consolidated Lead Company, at Desloge, Mo., decided to provide a new change room at its No. 6 mine, believing that, although it would not realize any money from it, the company would gain in increased loyalty and cooperation of the men in making other possible changes later, writes H. A. Neustaedter. The old compressor and hoist building, which was large and high, and had a concrete floor, was readily converted so as to house a combination storeroom, office room, change room, and room for sand dryer and heating plant.

Steam heat for both this structure and the new hoist and compressor building was provided by making use of a recently discarded locomotive crane boiler, which also supplied, through a Simms heater, hot water for the wash room. The effect on the men of this installation is considered by the management to be highly gratifying.

Canada's Gold Prospects

Recent Developments Forecast Further Expansion Of Both Mining and Exploration Operations

John B. DeMille
Consulting Geologist
Montreal, Canada

CANADA'S fast-growing mining industry has increased the per capita rate of gold production from $4.39 in 1929 to $7.08 for each of the 12,000,000 inhabitants in 1933, according to preliminary estimates by the Department of Mines at Ottawa. Far different is the record of production in the United States, where the per capita rate was down to 38c. in 1929, with an indicated increase for 1933 to 58c. for each of the 120,000,000 inhabitants. Over the twenty-year period from 1909 to 1929 United States gold production declined 66 per cent, whereas Canadian output was increasing at the remarkable rate of 363 per cent, as shown by statistics issued by the U. S. Bureau of Mines.

In building up this production record, Canada has won a place second only to the mining industry established half a century ago in South Africa. In the Dominion, "Outstanding is the success of the gold-mining industry," stated Sir Charles Gordon, president of the Bank of Montreal, at the recent annual meeting of the bank. Among Canadian industries gold mining has won a secure place, with its output closely approaching the value of agricultural products.

Operating mines are installing new equipment which will make possible substantial increases in gold output in 1934. The steady progress of exploration in opening up promising new fields leads to the belief that eventually Canada will become the world's foremost gold producer.

Last year, with gold valued at its standard price of $20.67 per ounce, Canadian output worth more than $63,000,000 came from the 45 active gold mines, of which eighteen were situated in Ontario, thirteen in British Columbia, six in Quebec, four in Manitoba, three in Nova Scotia, and one in Saskatchewan. The high premium on gold prevailing this year has had the effect of increasing the tonnage of low-grade ore which normally could not be mined at a profit. Although the quantity of refined gold recovered from Canadian ores in 1933 is not expected to exceed the figure for the preceding year, the actual market value of the metal produced in 1933 is estimated at $84,258,000 by the Dominion Bureau of Statistics.

Prospects for 1934 are particularly encouraging as a result of plans already announced by mining operators for increasing mill capacities by approximately 6,575 tons of ore daily. This added rate is scheduled to be in effect within the next six months. To the 45 mines reporting gold production last year, probably at least 32 new properties will be added, making a total of 77 milling plants contributing to Canada's gold output in 1934. At least twelve of the established mines will also have enlarged their existing plant capacities. Within the last three years Canadian gold output has advanced almost 50 per cent, and the prospects for vigorous mining expansion in 1934 are better than ever before.

Plans for Expansion in 1934

As shown in Table I, the Province of Quebec will have five new mills operating next year, and three established producers will have increased mill capacity, the greatest jump being the 1,000-ton addition to the Noranda concentrator. Manitoba is also establishing three new producers, and San Antonio (Table II) output will probably be doubled. British Columbia, ranking third in the value of gold output from individual provinces, is expected to have eight new mines, and two of the established operators will increase mill capacities. Ontario, with eighteen mines producing in 1932, is expected to have a total of 34 operators in 1934, including six of the large mines which intend enlarging the scale of development.

The companies listed in Table I have officially announced plans for work which is actually under way or is projected for the next few months. The number might be materially increased if those companies were included which have seriously discussed important construction work on mining properties now in various stages of development.

In addition to the mills tabulated, milling plans are being considered by at least eight Ontario companies, including Churchill, Casey Summit, McMillan, Matachewan Canadian, McCarthy-Webb, Halcrow Swayze, and Hollinger Reserve. In Quebec may be mentioned Normont, discussing a 50-ton mill; Thompson Cadillac, considering plans for a 100-ton mill; and Lamaque, controlled by Teck-Hughes, which may soon decide on large-scale milling equipment. Two British Columbia producers, Reno and Pioneer, are shortly to increase their daily output, and Surf Inlet plans to resume production.

The high price of gold has helped to stimulate mining activity in the Dominion to an unprecedented degree. Small portable mills are in active demand, sug-

Table I—New Canadian Gold Producers Announced for 1934

Province	Mining Property	Location	Capacity of Mill (Tons per Day)
Ontario	Young-Davidson (Hollinger)	Matachewan	500
	Canadian Associated (*a*)	Larder Lake	300
	Paymaster Consolidated	Porcupine	250
	Marbuan Gold (*a*)	Porcupine	150
	McEnaney (Lease) (*a*)	Porcupine	25
	Macassa Gold	Kirkland Lake	200
	Lakeland Gold	Kirkland Lake	100
	Bidgood Kirkland	Kirkland Lake	50
	Barry-Hollinger (*a*)	Boston Creek	100
	Beardmore (Newmont)	Northwestern Ontario	100
	St. Anthony	Northwestern Ontario	125
	Little Long Lac	Northwestern Ontario	75
	Jackson-Manion Cons.	Northwestern Ontario	50
	Central Patricia	Northwestern Ontario	50
	Blue Quartz	Munro Township	25
	Lucky Cross (*a*)	Swastika	20
Quebec	Greene Stabell	Bourlamaque Township	100
	Canadian Pandora	Cadillac Township	100
	Arntfield	Boischatel Township	100
	Matthews	Pascalis Township	50
	Sullivan Consolidated	Dubuisson Township	50
Manitoba	Oro Grande	Beresford Lake	50
	Island Lake (Ventures)	Island Lake	50
	Diana Gold	Gem Lake	40
British Columbia	Meridian Mining Co.	Camborne	300
	Taylor (Bridge River)	Hurley River	200
	Columario Consolidated	Omineca	50
	Wayside	Bridge River	100
	Noble Five Mines	Nelson	50
	Vidette Mines (*a*)	Deadman River	45
	Jewell (*a*)	Greenwood	100
	Nicola Mines & Metals (*a*)	Kamloops	100

(*a*) Formerly in production.

gesting the possibility that two dozen or more small properties throughout the country may install plants having capacities ranging from 5 to 25 tons of ore daily. Reviving interest in base-metal mining should also increase the amount of byproduct gold recovered in 1934.

The statistics in Table I, which were recently made available by the *Northern Miner* and other sources, show that Ontario is adding new mills having a daily capacity of 2,120 tons of ore; initial producing mines in Quebec will have a combined rate of 400 tons; British Columbia provides for expansion aggregating 945 tons; and Manitoba is installing 140 tons. The total amount of ore scheduled for 1934 production by new mines will amount to 3,605 tons every 24 hours.

Half of the properties listed in Table I are preparing to enter the production stage with mill equipment rated at less than 100 tons. In this connection one may recall with interest the modest beginnings of some of the large gold mines of today. Lake Shore has increased its mill capacity 46 times, McIntyre 40 times, Teck-Hughes 26 times. All three started production with 50-ton mills. A little over twenty years ago Hollinger installed a 5-ton test mill, followed by machinery handling 60 tons, and is now operating a 5,000-ton plant. The prosperity of gold mining in Canada is based on a policy of vigorous, shrewdly directed expansion.

Up to Dec. 31, 1933, the total value of all gold mined in Canada was $960,657,252, according to the Dominion Bureau of Statistics, based on the standard value of gold. The estimated exchange equalization on gold produced in 1932 and 1933 amounted to $31,924,310. The actual value of the total Canadian gold production to the end of 1933 falls short of the billion-dollar mark by only $7,418,438, which is about the value of the estimated output of the Dominion's gold mines during the month of January, 1934.

Figures listed in Table II show that thirteen mines now ranking as established producers will increase their 1934 combined output by approximately 2,970 tons daily. Quebec, ranking second to Ontario as a gold-producing province, is adding 1,250 tons, milling capacity, with prospects of a further increase of 200 tons. Ontario's proposed increase, based on official plans announced by six of the established operators, will amount to at least 1,185 tons daily. Four mines located in British Columbia and Manitoba will have a combined increase in mill capacity of 635 tons.

Expectations are that estimates submitted at this time will be substantially added to during the next twelve months. The subject of mill expansion is being discussed by practically every gold-mining company in Canada, and newly discovered orebodies and gold prospects in various stages of development are rapidly advancing to the production stage. Several of the increases listed in the two accompanying tables have already been put into effect. One would not seem to be unreasonable if one estimated that a minimum of increase of 7,000 tons per day will be in effect before the end of 1934, which represents annual production valued at more than $25,000,000, assuming that gold recoveries will average $10 per ton of ore treated. The value of gold produced in Canada in 1933, in Canadian dollars, was more than $13,000,000 in excess of the production for 1932. This rate of increase may be more than doubled in 1934, with total output in 1935 from 77 mines having a value of about $110,000,000.

The 1933 Dividend Record

Table III is included with this brief survey of the gold-mining industry in Canada in order to show how $27,125,804 in dividends was distributed by thirteen companies whose income is chiefly derived from gold production. Two Sudbury operators and two base-metal companies in British Columbia are added to complete the list of Canadian metal mines paying dividends in 1933. Coniagas, the last of the Cobalt operators to distribute dividends, has derived income from a large interest in Coniaurum. Howe Sound was the only dividend payer in 1933 distributing less than in 1932, whereas six gold producers show an increase over the preceding year's rate. One gold mine and one nickel mine are added to the list for the first time, and Consolidated Smelters return to the list after omitting dividends in 1932.

These dividend figures, as compiled by the *Financial Post*, show 1933 disbursements to shareholders of Canadian mining companies to be $3,296,572 in excess of the previous year's disbursement of $23,829,232. The all-time total of dividends paid by the mining industry in Canada now amounts to more than $537,000,000, of which total more than half has been paid to shareholders since 1920. Sudbury nickel mining has been responsible for dividend payments amounting to $149,710,797. Cobalt silver mines returned almost $100,000,000 to investors. The dividend record of British Columbia mining companies from 1896 to the end of 1933 amounts to $121,331,608. To the gold mines of the Porcupine camp is now credited $97,964,704, and Kirkland Lake has during its short history built up a grand dividend total of $53,996,645, more than half of which has been disbursed since 1930. The two Quebec producers (Noranda, starting dividends in 1930, and Siscoe, paying its first dividend in 1932) have so far distributed to shareholders a total of more than $12,000,000.

Table II—1934 Mill Enlargements Planned for Operating Mines

Province	Mining Property	Present Tonnage Capacity	New Tonnage Capacity	Increase
Ontario	Lake Shore	2,070	2,300	230
	Wright-Hargreaves	800	1,000	200
	Howey	800	1,300	500
	Buffalo Ankerite	340	500	160
	Sylvanite	250	325	75
	Parkhill	60	80	20
Quebec	Noranda Mines (copper-gold)	2,000	3,000	1,000
	Beattie Gold	850	1,000	150
	Siscoe Gold	300	400	100
Manitoba	San Antonio	160	300	140
British Columbia	Bralorne Gold	180	250	70
	Cariboo Gold Quartz	100	500	400
	Reno Gold	75	100	25

Table III—Canadian Dividend Payers in 1933

Province	Mining Company	Location	1933 Dividend Disbursement
Ontario	Lake Shore	Kirkland Lake	$6,000,000
	Teck-Hughes	Kirkland Lake	2,884,286
	Wright-Hargreaves (*a*) (*b*)	Kirkland Lake	962,500
	Sylvanite (*a*) (*b*)	Kirkland Lake	164,975
	Hollinger Consolidated	Porcupine	4,182,000
	Dome Mines (*b*)	Porcupine	1,716,001
	McIntyre Porcupine (*b*)	Porcupine	1,197,000
	Buffalo Ankerite (*c*)	Porcupine	42,102
	International Nickel (*b*) (*d*)	Sudbury	1,933,900
	Falconbridge Nickel (*c*)	Sudbury	799,889
	Coniagas Mines (now a holding company mainly interested in Coniaurum.)		96,415
	Howey Gold Mines (to pay first dividend in February, 1934)		
Quebec	Noranda Mines (*a*)	Rouyn Township	3,359,658
	Siscoe Gold Mines (*a*)	Dubuisson Township	641,209
Manitoba	San Antonio Gold (to pay first dividend in February, 1934)		
British Columbia	Consolidated Mining & Smelting (*a*)	Trail	1,480,125
	Pioneer Gold Mines (*a*)	Lillooet	735,735
	Premier Gold Mining (*a*)	Portland Canal	600,000
	Howe Sound (*e*)		330,000

(*a*) Increase over 1932 disbursement.
(*b*) Plus premium on United States funds.
(*c*) First dividend to be paid.
(*d*) On preferred stock only; dividends on common may be resumed in 1934.
(*e*) Includes profit from Britiannia and other properties.

Trends and Developments In the Industry

Congress Passes President's Monetary Bill —Devaluation Fixes Gold Price at $35

Gold Content of the Dollar Is Reduced 40.94 Per Cent—Pittman Amendment Authorizes Issuance of Silver Certificates Against Treasury Bullion and Provides for Their Use in Purchasing Offerings of Newly Mined Silver

IN PASSING the President's monetary bill on Jan. 29, Congress fixed the upper limit of permissible revaluation of the dollar at 60 per cent of its statuatory value. Two days later, the President, acting under the authority provided by the legislation, issued a proclamation reducing the gold weight of the dollar from 25.8 to 15 5/21 grains, 0.9 fine, making its gold value 59.06 per cent of the par fixed by the act of 1900; in other words the dollar is now worth 59.06c. in gold. The President is quoted as saying that he revalued the gold dollar at 59.06 per cent instead of 60 per cent so as to establish a round figure purchase price for gold. The new legislation provides further for the purchase of "any and all" gold at the aforesaid price and for the buying and selling of gold in foreign markets by the government, but it excepts for purchase by the government that gold being held in this country in non-compliance with earlier gold legislation. The weight of the silver dollar is not altered in any manner by the President's proclamation.

Through an amendment proposed in the Senate by Senator Key Pittman, however, enacted as part of the legislation, the use of silver for currency purposes may be expanded. In effect, the amendment authorizes a five-point currency program: first, to pay for the newly mined silver in certificates instead of in silver dollars; second, to issue certificates against the silver bullion which the Treasury is thus amassing; third, to issue certificates against all free silver now held in the vaults of the Treasury; fourth, to authorize the President to reduce the weight of the silver dollar in such amounts as may be necessary to maintain a parity with the gold dollar under the new revaluation policy, and, fifth, to increase the seigniorage, or mint fee, for coinage of foreign silver or silver not produced in the United States or its dependencies.

A much broader silver amendment proposal made in the Senate by Senator Burton K. Wheeler, of Montana, was defeated by a scant margin of two votes —45 to 43. It provided that the Secretary of the Treasury should be instructed to buy not less than 25,000,000 oz. of silver in four months and not less than 10,000 oz. a month thereafter until a total of 750,000,000 oz. had been bought. It also provided that the Secretary of the Treasury purchase this silver at home or abroad as he saw fit, and that silver certificates be issued payable to the bearer in silver bullion at the gold equivalent value at the time of demand, to the end that silver be measured by value rather than by weight. The purchase plan would have sought to establish a ratio of 16 to 1.

Appended are the paragraphs of the President's Jan. 15 special message to Congress that relate to revaluation and silver, that part of the text of the enacted legislation that provides for revaluation, and the text of the Pittman amendment:

President's Message—Revaluation

"The President is authorized by present legislation to fix the lower limit of permissible revaluation at 50 per cent. Careful study leads me to believe that any revaluation at more than 60 per cent of the present statutory value would not be in the public interest. I, therefore, recommend to the Congress that it fix the upper limit of permissible revaluation at 60 per cent.

"That we may be further prepared to bring some greater degree of stability to foreign exchange rates in the interests of our people, there should be added to the present power of the Secretary of the Treasury to buy and sell gold at home and abroad, express power to deal in foreign exchange as such. As a part of this power I suggest that, out of the profits of any devaluation, there should be set up a fund of two billion dollars for such purchases and sales of gold, foreign exchange, and government securities as the regulation of the currency, the maintenance of the credit of the Government and the general welfare of the United States may require.

"Certain amendments of existing legislation relating to the purchase and sale of gold and to other monetary matters would add to the convenience of handling current problems in this field. The Secretary of the Treasury is prepared to submit information concerning such changes to the appropriate committees of the Congress."

President's Message—Silver

"The foregoing recommendations relate chiefly to gold. The other principal precious metal—silver—has also been used from time immemorial as a metallic base for currencies as well as for actual currency itself. It is used as such by probably half the population of the world. It constitutes a very important part of our own monetary structure. It is such a crucial factor in much of the world's international trade that it cannot be neglected.

"I issued a proclamation providing for the coinage of our newly mined silver and for increasing our reserves of silver bullion, thereby putting us among the first nations to carry out the silver agreement entered into by sixty-six governments at the London Conference. This agreement is distinctly a step in the right direction and we are proceeding to perform our part of it.

"All of the sixty-six nations agreed to refrain from melting or debasing their

World Production of Gold

(American Bureau of Metal Statistics)

In Fine Ounces

	Dec. 1933	Jan.-Dec. 1933	Jan.-Dec. 1932
United States (*a*)..	270,000	2,537,000	2,449,000
Canada.....	255,000	2,945,000	3,044,000
Mexico.....	(*f*) 60,000	648,000	584,000
Colombia.....	(*f*) 35,000	386,000	248,000
Other South America.....	47,000	477,000	434,000
British India (*e*)...	28,000	335,000	330,000
Japan (*e*).....	(*f*) 40,000	436,000	397,000
Queensland.....	(*f*) 9,000	90,000	23,000
Western Australia.	56,000	637,000	606,000
Other Australasia (*b*).....	38,000	419,000	357,000
South Africa.....	894,000	11,025,000	11,559,000
Belgian Congo....	19,000	250,000	243,000
Rhodesia.....	55,000	642,000	581,000
British West Africa	29,000	335,000	293,000
Russia (*c*).....	(*f*) 160,000	1,920,000	1,900,000
Elsewhere (*d*).....	(*f*) 100,000	1,200,000	1,178,000
Totals.....	2,095,000	24,282,000	24,226,000

(*a*) Includes Philippines. (*b*) Includes New Zealand and New Guinea. (*c*) Chiefly Siberia; 1933 estimated at average rate of 1932. (*d*) Includes West Indies, Central America, Europe, and Asiatic and African lands not separately reported: estimated. (*e*) Principal mines; nearly complete. (*f*) Conjectural.

silver coins, to replace paper currency of small denominations with silver coins and to refrain from legislation that would depreciate the value of silver in the world markets. Those nations producing large quantities of silver agreed to take specified amounts from their domestic production, and those holding and using large quantities agreed to restrict the amount they would sell during the four years covered by the agreement.

"If all these undertakings are carried out by the governments concerned, there will be a marked increase in the use and value of silver.

"Governments can well, as they have in the past, employ silver as a basis for currency, and I look for a greatly increased use. I am, however, withholding any recommendation to the Congress looking to further extension of the monetary use of silver because I believe that we should gain more knowledge of the results of the London agreement and of our other monetary measures."

Revaluation Legislation

Sec. 12. Paragraph B (2) of Section 43, Title III of the act approved May 12, 1933 (Public No. 10, Seventy-third Congress), is amended by adding two new sentences at the end thereof, reading as follows:

"Nor shall the weight of the gold dollar be fixed in any event at more than 60 per centum of its present weight. The powers of the President specified in this paragraph shall be deemed to be separate and distinct powers and may be exercised by him, from time to time, severally or together, whenever and as the expressed objects of this section in his judgment may require."

Pittman Amendment

The Pittman silver amendment reads as follows:

The President, in addition to the authority to provide for the unlimited coinage of silver at the ratio so fixed, under such terms and conditions as he may prescribe, is further authorized to cause to be issued and delivered to the tenderer of silver for coinage, silver certificates in lieu of the standard silver dollars to which the tender would be entitled and in an amount in dollars equal to the number of coined standard silver dollars that the tender of such silver for coinage would receive in standard silver dollars.

The President is further authorized to issue silver certificates in such denominations as he may prescribe against any silver bullion, silver, or standard silver dollars in the Treasury not then held for redemption of any outstanding silver certificates, and to coin standard silver dollars or subsidiary currency for the redemption of such silver certificates.

The President is authorized, in his discretion, to prescribe different terms and conditions and to make different charges, or to collect different seigniorage, for the coinage of silver of foreign production than for the coinage of silver produced in the United States or its dependencies.

The silver certificates herein referred to shall be issued, delivered, and circulated substantially in conformity with the law now governing existing silver certificates, except as may herein be expressly provided to the contrary, and shall have and possess all of the privileges and the legal tender characteristics of existing silver certificates now in the Treasury of the United States, or in circulation.

The President is authorized, in addition to other powers, to reduce the weight of the standard silver dollar in the same percentage that he reduces the weight of the gold dollar.

The President is further authorized to reduce and fix the weight of subsidiary coins so as to maintain the parity of such coins with the standard silver dollar and with the gold dollar.

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PWA Allotments Expand Work of Technical Bureaus

Recent allotments announced by the Federal Emergency Administration of Public Works include the following made to the U. S. Bureau of Mines, U. S. Geological Survey, and the U. S. Bureau of Reclamation:

To the Bureau of Mines $200,000 for new construction work at its experimental station at Pittsburgh, reconditioning existing structures at that station, and reconditioning the Bureau's experimental mine at Bruceton, Pa.

To the Bureau of Mines $55,000 for reconditioning its petroleum experiment station at Bartlettsville, Okla.

To the Bureau of Mines $16,800 to be used for preparing plans and specifications for an experiment station and laboratory to be built at College Park, Md.

To the Geological Survey, $299,000 for mineral resource surveys and land classification in eighteen states and in Alaska. The states in which the surveys will be conducted and the amounts to be expended in each are: Alabama, $22,000; Alaska, $50,000; Arkansas, $29,500; Florida, $11,000; Georgia, $9,000; Illinois, $2,500; Kansas, $12,000; Kentucky, $24,500; Maryland, $5,000; Michigan, $15,000; Mississippi, $5,000; Missouri, $5,000; New York, $23,000; North Carolina, $8,000; Oklahoma, $24,000; South Carolina, $7,000; Tennessee, $9,000; Texas, $34,500; West Virgina, $3,000.

To the Bureau of Reclamation $25,000 for an industrial survey in the Boulder Dam area. The purposes of the survey are to ascertain the location, extent and commercial value of all mineral resources within a radius of 200 miles of Boulder Dam, and to determine to what extent the power generated by the dam may be made a factor in the development of mineral and manufacturing interests in that area. The survey, in which the U. S. Geological Survey will cooperate, will soon be started.

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Kakamega Results Promising

The development work directed by Tanganyika Concessions-Zambesia Exploring in the Kakamega gold fields of Kenya Colony is disclosing narrow veins of persistence and high values. A number of mills will probably be erected in the district during the next dry season.

Canadian Institute Will Hold Annual Meeting at Quebec

The Canadian Institute of Mining and Metallurgy will hold its 35th annual general meeting on April 3-5 at the Chateau Frontenac in the city of Quebec. Following long-established precedent, the Canadians invite and will heartily welcome any men from other lands who are interested in mining and the mineral industry. A symposium will be held on Flin Flon operations; metallurgy at Trail and Falconbridge will be discussed; and developments in the gold fields of British Columbia. An outline of the technical program is appended.

Program

Geological

"Geology of British Columbia Gold Fields," by Victor Dolmage

"Geology of the Vipond Mine," by E. Y. Dougherty

Geology of the Beattie Mine," by J. J. O'Neill

"Geology of the Horne Mine, Noranda," by Peter Price

Industrial Minerals

"Recent Developments in the Sodium Sulphate Industry," by L. H. Cole

"Mining Methods at the King Mine" (an account of the block-caving recently introduced by the Asbestos Corporation), by J. G. Ross

"A Non-wasting Industrial Mineral," by A. W. G. Wilson

Milling and Metallurgy

"Ore Treatment at Falconbridge," by Gill and Mott

"The Trail Leaching Process and Treatment of Fume Produced From Lead Blast Furnace Slag," by Hannay and Bryden

"The Flin Flon Mill, Smelter, and Zinc Plant," by the staff, Hudson Bay Mining & Smelting Company, Ltd.

Mining

"Sublevel Stoping," by A. Hasselbring

"Guniting at the McIntyre, by D. E. Keeley

"The History, Development, and Practice of the Hudson Bay Mine," by the staff, Hudson Bay Mining & Smelting Company, Ltd.

"Power Development for Flin Flon," by the staff, Hudson Bay Mining & Smelting Company, Ltd.

Prospecting

An entire session will be devoted to this subject. The greater part of the session will be allotted to descriptions of practice and outstanding discoveries by practical prospectors. Brief papers will describe:

Organization and Service of a Provincial Prospectors' Association

Use of Government Maps and Reports

Equipment of a Prospecting Party

A Satisfactory "Grubstaking" Agreement

A Fair Deal for a Prospect

General

"The Companies Information Act and Security Frauds Act, Quebec," by W. Amyot

"The Tax Return of a Mining Company," by E. D. Fox

"Blue-sky," Laws, by W. E. Segsworth

"Mine Taxation," by the President (Balmer Neilly)

Rapid Growth of Canadian Mining Industry To Continue During 1934

RECENT developments in various Canadian mining districts indicate a steady continuation of the rapid progress that characterized the Dominion's mining industry in 1933. Evidence of this is seen in the many extensions that are being made to the electric power lines, to serve the more remote mining areas. Increased milling capacity that is being installed at many properties is similarly indicative. A summary of the more important developments in the various provinces follows:

British Columbia

Shareholders of Bralorne Mines ratified on Jan. 4 proposals for the creation of a subsidiary to be known as the Bradian Mines, to acquire and operate the southeast section of the Bralorne property comprising 26 mineral claims, or 773 acres. The northern part of the property remaining to the Bralorne company comprises 849 acres and includes the Lorne mine, on the development of which the company has concentrated effort with eminently gratifying results. The decision to subdivide the property was based on the desirability, in view of the high price of gold, of developing the southern part of the property, which has very promising possibilities, without delay. Capacity of the Bralorne mill has been stepped up to a rate of 200 tons per day, and this will soon be increased to 250 tons.

Arrangements have also been made for financing the Wayside mine, in the same district, to production. Construction of a mill, the first unit of which will have a capacity of 100 tons daily, will be started shortly.

Developments at other mines in the Bridge River district have been unusually satisfactory within recent weeks. At the Pioneer a remarkably rich oreshoot, having a width of from 2.5 ft. to 6.5 ft., with a high average gold content, has been opened on the 5th level for a distance of more than 400 ft., and equally rich ore has been found recently in a new discovery on the 14th level. Favorable results of development at the Minto and BRX properties are also reported, satisfactory values having been indicated at the latter by diamond drilling at a depth of about 400 ft. below the tunnel workings.

In the Nicola district, systematic development by Nicola Mines & Metals on the Mineral Hill properties at Stump Lake is beginning to bear fruit. More than 2,300 ft. of new development work has been completed. Drifting is in progress in three directions on the Joshua and Tubal Cain veins, and all development faces are in ore. The adjoining Gold Reef Mining Company's properties of 22 claims were recently acquired on royalty basis by the Reward Mining Company, Ltd., of Vancouver.

In the Kamloops area, the newly equipped mill on the Vidette gold mine recently went into commission.

The old Jewel mine, in the Boundary district, owned by the Dentonia Mines, promises to be much more profitably productive than when operated about twenty years ago. A 100-ton mill, using flotation, is being constructed and is expected to be in operation within three months.

In the Nelson district, the milling capacity of the Reno is being increased from 75 to 100 tons a day. Sheep Creek Gold Mines has been incorporated, to acquire a group of properties comprising 21 claims and fractions in the Sheep Creek area, including the old Queen mine.

On the Coast, Premier Gold Mining has secured an option on the Alexandria Gold Mines, on Phillips Arm, where an exhaustive exploration program will be carried out.

In the Portland Canal district, financial arrangements have been completed for the rehabilitation of the mill and the resumption of mining operations at the Dunwell property. Consolidated Mining & Smelting has entered into an agreement to undertake the development of the Salmon Gold group of 26 claims on the west side of Summit Lake, owned by Salmon Gold Mines.

Ontario

The effect of higher prices for gold is shown strikingly in the instance of Buffalo-Ankerite Gold Mines, at Porcupine. Equipped with a first-rate 200-ton mill and with a well-developed mine, the property failed to pay ten years ago. The Buffalo men who acquired the property at a small cost are now making a handsome profit, the amount being approximately equal to the increase in gold values.

Moss Mines, in northwestern Ontario, which gave inconclusive results after a year's milling, has now been reorganized as Ardeen Gold Mines, and a Rochester group have provided funds to investigate further the possibilities of its vein system laterally and at depth.

Coniaurum has reaped the first fruits of its present campaign of exploration at depth, encountering a new and high-grade vein on the 1,500-ft. level.

Quebec

Following its recent announcement of an extension eastward of a power line from Rouyn to Cadillac, a distance of 35 miles, Canada Northern Power has now decided to extend it an additional 35 miles to the active gold area in which the Siscoe, Greene-Stabell, and Bussières mines are producing, and where the Lamaque promises to develop into a large mine of fair grade.

Manitoba

As a result of favorable development of several new veins discovered in the course of underground prospecting, San Antonio will authorize an expansion which will double the capacity of its 160-ton mill. A new central shaft has been started that is expected to reach its objective of 1,000 ft. by next June.

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Torreon Smelter of Peñoles To Reopen March 1

The American Metal Company has announced that the Torreon smelter of its subsidiary, Cia. Minera de Peñoles, S. A., situated at Torreon, Coahuila, will be reopened on March 1. The plant is equipped with six blast furnaces, and has a daily capacity of 1,250 tons of ore.

Blasting in pit No. 7 of the October group of asbestos mines situated at Asbest in the Urals, U.S.S.R. Both underground and open-cut methods are used. Headframes above two of the shafts are seen in the upper right. High-speed hoisting is employed

Metal and Non-Metallic Mining Codes Continue Under Discussion

DELIBERATIONS on the codes for the three major non-ferrous metal industries—copper, lead, and zinc—continued during January, with the copper interests still unable to reach an agreement on a proposed code to be presented for public hearing. During the month a code for the slate industry and one for the feldspar industry were approved. Public hearings were held on proposed codes for the sandstone, fuller's earth, gypsum, and maganese industries; summaries of these hearings are appended.

Sandstone—Labor representatives objected to the hours and wages provisions of the proposed code of fair competition for the sandstone industry at a hearing held on Jan. 3 by Assistant Deputy Administrator Ralph J. Fogg. No changes in the other provisions of the code were suggested.

The code was presented by Robert Wynn for the National Sandstone Association, Inc. Mr. Wynn explained that this association was organized only recently, but stated that it is "truly representative" of the industry. He assured the administrator that the code as submitted has the unanimous endorsement of those engaged in sandstone production. The only other witnesses were those representing labor groups. Waldo C. Holden, of the American Federation of Labor, appeared for the Quarry Workers Union of North America. Albert M. Anderson presented the representations of the Paving Cutters Union, and M. W. Mitchell appeared as president of the Journeymen Stonecutters Association of North America. Mr. Mitchell also sat with the administrator as a labor adviser, representing the Labor Advisory Board.

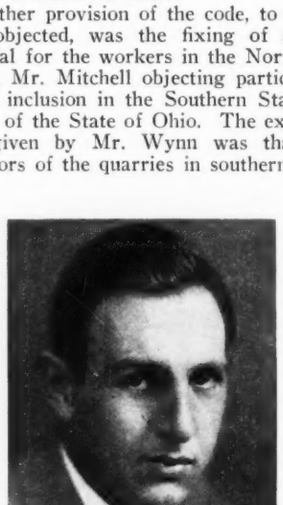
The three labor spokesmen urged upon the administrator the advisability of lowering the allowable hours and increasing the wage rates proposed. Both Mr. Holden and Mr. Mitchell suggested that the maximum work week be fixed at 30 hr. The proposed maximum is 40 hr., but with provisions that under certain conditions men might be permitted to work 48 hr. Mr. Holden argued that an analysis of this labor provision revealed that in effect the maximum week would therefore develop to be one of 48 hr.

The minimum wage rate proposed is 38c. an hour except in the South, where it would be fixed at 33c. an hour.

Both Mr. Holden and Mr. Mitchell insisted that the rate was too low, Mr. Holden saying the minimum should be 50c. and Mr. Mitchell arguing that under no circumstances should less than 38c. be paid and perhaps 40c. Mr. Anderson, who suggested that the maximum hours for paving cutters be fixed at 35, suggested that the wage rate be fixed at slightly more than that prevailing in 1929. He also suggested that a provision for periodical wage revision be written into the code.

Mr. Mitchell also sought the inclusion of provisions to regulate more thoroughly the letting of contracts and contract peddling, particularly in the case of the carvers. Both Mr. Holden and Mr. Mitchell recommended the setting up of an industrial relations board.

Another provision of the code, to which both objected, was the fixing of a differential for the workers in the North and South, Mr. Mitchell objecting particularly to the inclusion in the Southern States of a part of the State of Ohio. The explanation given by Mr. Wynn was that the operators of the quarries in southern Ohio competed more directly with those in the South.



James S. Burch

Resigning last November from the position of research engineer with the Wire Reinforcement Institute to join the staff of the NRA, Mr. Burch since then has been serving as an Assistant Deputy Administrator, dealing largely with construction materials. From 1928 to 1930 he was with the American Road Builders in Washington, D. C. Following his graduation from Duke University in 1921, he joined the engineering staff of the North Carolina Highway Commission, continuing with the commission during the following six years.

The hearing was adjourned subject to call by the administrator.

Fuller's Earth—At a public hearing held on Jan. 5 the code of fair competition for the fuller's earth producing and marketing industry was amended so as to become effective after approval by the NRA administrator instead of by the President. This is in conformity with the recent Executive Order relieving the President of code approvals for smaller industries, and transferring that authority to General Johnson.

No opposition was offered to the code and only its proponents appeared before Assistant Deputy Administrator James S. Burch, who conducted the hearing, assisted by these Advisers: B. A. Brennan, industrial; John L. Goslin; W. J. Norton, consumers; Dr. Spencer Reed, planning and research; Joseph McConnell, legal.

A. C. Jackson, Watten, Pa., chairman of the committee sponsoring the code, and representing the industry, explained that fuller's earth is a natural clay-like mineral substance used primarily in granular form for decolorizing or filtering oils and fats. Most of it is sold to petroleum refiners. Its consumption increased greatly until 1930, when the development of substitute processes began to decrease the use of fuller's earth and it slumped, by 1932, from 93 to 29 per cent of the total consumption of decolorizing mediums used in the Mid-Continent oil field. At the same time the refiners learned how to use the same fuller's earth, over and over, as many as thirty times, instead of the previous three to seven times. These unfavorable factors appear to be permanent for the industry, said Mr. Jackson, and accordingly the benefits ordinarily to be derived from the NRA will have no appreciable effect.

Plants of this industry are located in rural communities in Florida and southern Georgia, in order to be adjacent to their deposits. The labor supply is "largely unskilled and comparatively inefficient and is composed of a large percentage of Negroes," Mr. Jackson said. There have been no labor troubles; wages paid at these plants have been considerably higher than those paid by other employers in surrounding territory, and the code's minimum wage (22½c. per hour) is about 25 per cent higher than that paid previous to August, 1933. The code's maximum work hours (44 per week) will require approximately 10 per cent additional employees.

"We are surrounded by plantations whose owners feel that we are creating dissatisfaction among their own hands by working as few hours as we do," Mr. Jackson added.

The hearing was adjourned indefinitely, subject to call.

Gypsum—Sponsors of the code of fair competition for the gypsum industry on Jan. 9 submitted their proposed draft to Assistant Deputy Administrator John T. Lynch at a public hearing. Laurance I. Neale, representing the Gypsum Association, formally presented the document to the administrator.

In a lengthy supporting statement Mr. Neale disclosed that his group constitutes a majority of the industry, both in numbers and tonnage, producing some 90 to 95 per cent of the industry's total tonnage. He cited the drop in production of from 4,500,000 tons in 1929 to approximately 1,160,000 tons in 1933, stating that the industry suffered in proportion to the great decline in construction activities during these years. When the proposed code becomes effective, Mr. Neale asserted, a 16 per cent increase in employment will result, and, he continued, should production reach the 1929 level, employment will increase 168 per cent under the terms of the proposed code.

Neale proposed several clarifying amendments to various provisions of the code, to which no objection was voiced by any of those present.

Waldo C. Holden, speaking for the American Federation of Labor, said he recognized the curtailed demand for gypsum during the last ten years, but, he insisted, the price of gypsum products, during that period, has increased despite this markedly decreased production, and for that reason "there should be a fair share for the workers in this industry." He objected to any wage differential in the code and proposed a minimum wage of 50c. per hour and a maximum work week of 35

hr. This maximum work week, he continued, is ample to take care of peak seasons or fluctuating periods.

Defending the minimum wage and maximum hours provisions, Mr. Neale again returned to the stand and testified that production in the industry is not only seasonal in nature, but suffers from severe weekly fluctuations which cannot be anticipated. He characterized these provisions of the code as a "real contribution to NRA," and declared further that the proposed rates "would provide a minimum wage at least equal to, and in most cases exceeding, the buying power of the wage rate paid in 1929."

John E. MacLeish, representing the U. S. Gypsum Company, stated that the group for whom he spoke produced 48 per cent of the industry's total production, and though they did not feel they should be accorded that percentage of representation on the code authority, they did believe tonnage should play an important part in determining the representation on that body. He was assured by Mr. Neale that code proponents were anxious to arrive at an agreement that would be satisfactory to all concerned, although, Neale said, he was cognizant of the difficulties to be overcome in arriving at a fair method of basing this representation.

J. S. Kelley, of the Kelley Plasterboard Company, asserted that though he did not object to a provision in the code prohibiting sales below cost, he did see serious objection in the method prescribed for determining this cost. If cost is computed in this manner, Kelley continued, "we would be forced out of business," and he was supported in this belief by both MacLeish and Howard Houston, the latter speaking for the Structural Gypsum Corporation.

The hearing was recessed subject to reconvening by the administrator.

Manganese — Importers of manganese would be banned from selling ore below the prevailing price in this country under amendment proposed to the pending code of fair competition for the manganese industry by Bernard S. Barron, counsel for the American Manganese Producers Association, at a public hearing held on Jan. 26, at which Deputy Administrator W. A. Janssen presided.

Manganese operators from Virginia to Montana were represented at the hearing and assisted in the presentation of evidence as to conditions in the industry. Expressing dissatisfaction over the protection at present afforded them, code sponsors declared that in order to adhere to the maximum hours and minimum wage provisions of the proposed code, "ruthless and unfair foreign competition" must be curbed. If this is not done, Mr. Barron stated in submitting the proposed amendment to the administrator, "thousands of men will be denied employment and in the event of national emergency, national defense will be impaired if not made impossible." He was supported briefly by Mrs. H. R. Butler, who identified herself as a manganese operator of Virginia, owning and operating fourteen companies in that state.

Under another amendment proposed by Mr. Barron, maximum hours for employees would be limited to 40 per week, "averaged over a three-month period," as against the straight 40-hr. week proposed in the code. This proposal was the subject of an objection voiced by J. S. Gould, representing the NRA Labor Advisory Board, who also asked that employees receive one and one-half pay for overtime in lieu of the one and one-third rate provided in the code, and that office employees receive the same rate of pay regardless of population of towns where they are employed.

Speaking further to the section on minimum wages, Mr. Gould attacked the 35c. per hour minimum as "entirely inadequate," and urged that a definite differential be established between workers employed above and below ground.

William H. Edmonds, speaking for the Consumers' Advisory Board, urged the deletion of certain provisions of the fair trade practice section, pointing out that there was an apparent attempt to suppress fair competition within the industry and a spirit "definitely opposed to consumers' interest." He expressed a desire to discuss provisions of the fair trade practice section with code proponents at a post-hearing conference.

John T. Lynch

Prior to assuming his duties as Assistant Deputy Administrator in the NRA, Mr. Lynch was a member of the engineering staff of the Kentucky Highway Commission, devoting much of his time to bridge construction and drainage surveys. He served overseas during the World War as a captain in the Corps of Engineers. Immediately after the war he was with the Kentucky & West Virginia Power Company. Following his graduation from the University of Wisconsin in 1914, Mr. Lynch was engaged on valuation investigations for the Southern Railway Company.

J. Carson Adkerson, chairman of the code committee, and manganese operator in the Shenandoah Valley section of Virginia and sections of Tennessee, stated that the Western and Southern states produce most of the ore in this country. In response to a question by the deputy, Mr. Adkerson asserted that Puerto Rico offers an increasing source of competition to the industry, and that it was the intention of code sponsors to include the island in their proposed code.

Other members of the industry who were heard at the session of Jan. 26 included: J. Reed Dennison, and O. J. Graham and Montis Smithson, of the Piedmont section of Virginia; and John Cole, operator of a nodulizing plant in Butte, Mont. All testified as to the minimum wages and maximum hours obtaining in their respective sections of the country.

George E. Dix, of New York City, representing the Steel Union Company, and Thomas H. Brown, of the American Federation of Labor, were also among those testifying at the session.

Various NRA advisers present at the hearing included: Carrol Burton, of the Industrial Advisory Board; William H. Edmonds, Consumers Advisory Board; A. G. White, Research and Planning Division; J. S. Gould, Labor Advisory Board; and Charles J. Munnz, Jr., of the Legal Division.

Deputy Administrator Janssen recessed the hearing subject to further call by the administrator.

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American Mining Interests Active in Mexico

More American mining interests will enter Mexico as the result of the recent sale in Nogales, Ariz., of mining lands at Mulatos near Cuaymas, Sonora, by William Croker and Florencio Romero to a Nogales syndicate for $20,000 (U. S.) . . . Thomas E. Campbell, former Governor of Arizona, recently completed an inspection of mining properties that he and associates own in the Altar district, Sonora. More than $100,000 (U.S.) worth of modern machinery and equipment will be installed early next year. . . . Shafts are being prepared and the mill is to be overhauled at the San Francisco del Oro property, Chihuahua, for an early resumption of activities by San Francisco Mines of Mexico. The company plans to build an aërial tramway from the mines to the mill. . . . Directors of Minas Los Lugos, S.A., operating at Mezquital del Oro, Zacatecas, have decided to make various improvements, including adding more machinery and changing the mill flowsheet.

W. B. Ladd has completed examining for Rochester, N. Y., interests, the Sangre de Cristo mine near Guazapares, Chihuahua, which is owned by A. R. Schloesser. . : . Promising gold deposits are reported to have been uncovered by recent torrential rains at Barranca de los Puercos, rear Villa Victoria, Michoacan. . . . From 25 to 40 kilos of gold are being shipped monthly from the San Jose de Gracia mine, near Santa de Gracia, Sinaloa, where old dumps are being re-treated by the cyanide method.

American Smelting has resumed work in its La Descubridora mine, Chihuahua, and the Cerro de San Pedro mine, San Luis Potosi. . . . Phillips Mining has extended its operations in the Carbo region, Sonora. . . . Guanacevi Exploitation and Mining, backed by American capital, has been organized in Durango City, to work mineral deposits in the Guanacevi region, Durango. The company intends to begin operations this month. American Smelting has

filed an injunction suit in the Chihuahua federal courts to prevent the enforcement of higher minimum daily wage scales for employees of its Santa Eulalia unit, Chihuahua. This is the first suit of the kind to be brought by a mining company operating in Mexico.

The Sonora state government has invited Senator Key Pittman to attend a homage festival at Nogales, which will be given by miners of that and other Mexican states as a token of appreciation of his efforts in behalf of silver.

Carnegie Metals has begun working mineral lands leased in the El Bote zone, Zacatecas. . . . Rich gold and silver tracts at Tayoltita, Guanacevi region, Durango, are being worked by San Luis Mining. A force of 600 men is employed installing machinery, developing the property, and in erecting office and other buildings. . . . Sulphur refinery, with a daily capacity of from 800 to 900 metric tons, has been established near Venado, San Luis Potosi, by S. Reuben Solis, owner and operator of the Mina El Fenix y Anexas, situated near the plant. . . . New York interests have acquired the El Arco mine at Camallie, Lower California, and intend to enlarge the milling plant to 75 metric tons daily capacity. . . . Cia Minera Aurifera Leon Grande de la Baja California, at Punta Prieta, Lower California, backed by American capital, is arranging to increase the capacity of its milling plant to 25 metric tons daily.

Real del Monte Mining has encountered a rich vein in its Moran mine at Pachuca, Hidalgo, and has contracted with the owners of six mining lands near Pachuca to exploit their properties. . . . Cia Minera El Rubi has been organized in Pachuca to work properties in the El Fraile zone, Hidalgo.

A Mexican company is being organized at Pachuca, Hidalgo, to operate gold and silver deposits in the "El Fraile" zone.

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Roan Antelope Adds New Furnace To Its Luanshya Smelter

Roan Antelope Copper Mines is erecting the second reverberatory furnace in its smelter at Luanshya, Northern Rhodesia. This furnace will have a suspended arch, somewhat similar to the arches at the Flin Flon property, and the smelting zone of the arch will be of magnesite brick. No. 1 furnace was down for a few days early in January for arch repairs A demand prevails for more Roan Antelope copper for fire-refining than is being produced; but present intentions are not to increase output. A report was circulated that Roan Antelope was about to sink a shaft on its Muliashi property, but this is definitely denied.

A new 75-ton cyanide plant in the Little Rocky Mountains of Montana—that of the Little Ben Mining Company, near Landusky—which has been in continuous operation since last September. Precipitation is effected with zinc dust, and the precipitate is collected in bags. The plant was designed and constructed by W. M. McClean

Base Metal Operations in Eastern Canada Keep Pace With Improved Conditions

ALTHOUGH gold holds the center of the stage at present in Canadian mining, the base metals are in a position that is similarly striking, even though they enjoy no such advantage as is derived from the so-called "bonus" on gold. Most of the base-metal mines in Canada possess natural advantages that permit marketing of the metals throughout the world at even the lowest prices reached recently. Mining activity has responded immediately to the present rise in prices, and operators are probably obtaining more than a proportionate amount of the increased world business.

Flin Flon continues to operate at a daily capacity of 4,000 tons, and is shipping its zinc as rapidly as produced from the Flin Flon refinery, as it is likewise doing with its copper produced at the refinery in Montreal. The Sherritt-Gordon property remains closed.

International Nickel, the largest single factor in Ontario mining, is operating its mines and smelters at about the level of their production in 1928-29, which corresponds to about 60 per cent of their present capacity of 180,000,000 lb. of nickel a year. The copper byproduct is being sold readily, mainly in overseas markets. Falconbridge Nickel is at the limit of its recently increased capacity of 750 tons a day mine output. The small Collins and Kingdon lead properties remain closed.

Noranda, in common with the Frood, at Sudbury, and the Sullivan, in British Columbia, has the advantage of an unusually high value per ton, in addition to large bodies of ore. Though mines like Flin Flon, Britannia, and Granby (Anyox) have managed to meet the period of low metal prices and restricted markets by means of truly remarkable feats of technical management, Noranda has been able to increase its gold output without increasing its copper production and thus to maintain its total output. It has steadily improved both its ore reserves and its facilities for milling and smelting without interfering with dividends.

The Aldermac mine is operating its 500-ton mill, the high-grade pyrite concentrate being shipped to Chicago and the copper concentrate going to the near-by Noranda smelter. As the two-compartment shaft formerly in use limited the daily tonnage to 500 tons, a third compartment has now been provided. Waite and Amulet copper mines have not yet resumed shipments to the Noranda smelter. The Abana copper-zinc mine is being prepared for production, the ore from which will be treated at a 500-ton mill by its new owner, Normetals Mining Corporation, controlled by Mining Corporation of Canada.

Eustis mine, in the Eastern Townships of Quebec, the oldest operating metal mine in Canada, continues the steady output which was commenced in 1864. The copper concentrate and most of the pyrite concentrate are shipped to the United States. The Stirling copper-zinc mine, in Nova Scotia, remains closed.

For more than thirty years Quebec has supplied the world with asbestos. At the forthcoming annual meeting of the Canadian Institute of Mining and Metallurgy James G. Ross will describe mining methods recently adopted at Thetford which permit of selective mining at low cost. These methods and other improvements promise to retain for Quebec for many years leadership in the asbestos industry.

Activity in Western Silver-Mining States Increases Further in January

SILVER at 64½c. an ounce seems to have had a pronounced stimulating effect on many of the Western mining districts. In Utah, mines are being reopened, and one company at least—Silver King Coalition—has announced an increase in wages that results in miners receiving $4.50 a day and muckers $4. Incidentally, another company is working its Silver and Roosevelt veins, which would seem particularly fitting. Anaconda Copper Mining has started operations at its Flathead silver mine, near Kalispell, Mont., and Treadwell Yukon is unwatering the Tybo mine, in Nye County, Nev., which has been shut down since October, 1932, when the price of silver dropped to 26c. A summary of the major developments last month in the principal mining districts follows:

Utah

Silver King Coalition Mines, operating at Park City, Utah, effective Jan. 1, increased the wages of all mine and salaried employees 10 per cent. This increase, resulting from the benefits of the rise in the price of newly mined silver to 64½c., restores the Silver King Coalition wage scale to near the normal level. Under the new schedule, according to M. J. Dailey, general manager, miners will receive $4.50 a day and muckers $4. The wages of 500 mine employees were effected by the new scale.

As a direct result of the increase in the price of silver, Utah Apex Mining, at Bingham, Utah, has reopened its property and put twenty men to work cleaning out the upper workings. Whether the company will unwater the mine below the 1,600 level has not been decided. Leasers are shipping from the 175 level.

Regular shipments of high-grade gold ore are being made from the Yankee mine of American Smelting & Refining in Mary Ellen Gulch, American Fork Canyon, 40 miles southeast of Salt Lake. Production is holding at the rate of 500 tons monthly.

Approximately 60 tons of silver ore is mined and shipped daily from the Park City Consolidated property in the eastern end of the Park City, Utah district. Four stopes are being mined, three on the Silver vein and one stope on the Roosevelt. A winze is being sunk in the south end of the property on the Crescent fissure. Thirty men are employed.

Opening up of a body of high-grade copper-gold ore in the Utah Metal and Tunnel property at Bingham by A. E. Kipps, who has a lease on the upper workings down to the 1,000 level, has aroused great interest in Salt Lake City. The strike was made in the Highland Boy limestone, one of the most prolific producers in the Bingham district. Struck on the 450 level, the ore has been proved for a depth of 70 ft. and a length of 100 ft. Below the 1,000 level, American Smelting & Refining has a lease on the property and is sinking a three-compartment shaft from the Armstrong tunnel level.

Nevada

Treadwell Yukon is unwatering the Tybo silver-lead-zinc mine, in Nye County, preparatory to resuming mining and milling as the direct result of the advance in the price of silver to 64½c. Operations were suspended in October, 1932, when silver dropped to 26c. The 300-ton flotation mill produces zinc and silver-lead concentrates.

Arizona-Comstock, at Virginia City, W. J. Loring, managing director, plans to erect a 120-ton cyanide unit, to treat concentrate and tailing from the flotation mill, and to increase the capacity of its mill to 300 or 400 tons a day. At Silver City, on the southerly end of the Comstock lode, a 150-ton cyanide mill, now under construction, will be completed by March 1 at the Dayton Consolidated property. Consolidated Chollar, Gould & Savage, operating the Overman and New York mines, at Gold Hill, will increase the capacity of the 50-ton pilot flotation mill to 100 tons.

Bradshaw, Inc., milling tailing from the Goldfield Consolidated mill since 1927, is enlarging its cyanide plant from 1,000 to 1,500 tons. Walter W. Johnson, president of General Recovery Metals, which has leased the tailing of Tonopah Mining at Millers, 15 miles west of Tonopah, announces that tube mills will be added to the equipment to regrind the sands to 200 mesh. E. A. Wiltsee has leased dumps of four mines from Nevada States Gold Mines at Seven Troughs and the cyanide mill of that company.

Montana

Anaconda Copper Mining has started operations at its Flathead silver mine, in the Hog Heaven district, Flathead County, near Kalispell, according to announcement made by James J. Carrigan, general superintendent of mines. The property shut down in August, 1930, after having shipped a substantial quantity of high-grade silver ores. The revival is the result of the higher domestic price for the white metal.

Basin Montana Tunnel has opened a virgin high-grade orebody, 14 ft. wide, on the 500 level east, in the Grey Eagle mine. The ore, which contains lead, zinc, gold, and silver, has been drifted on for a distance of over 230 ft. This is the largest orebody of that nature opened in the county in twenty years. The company also is opening its Comet mine and increasing ore reserves. A mill will be built early in the spring under the supervision of George Griswold, Butte metallurgist.

Arizona

With silver at its present price, activity in the mines around Tombstone is greater than it has been for years. About 145 men are employed in the mines of the camp, 80 of them at the Tombstone Extension unit of American Smelting & Refining, the San Diego, and Tombstone Development, and the remainder on leases. Leasers near Superior are making shipments to the Magma smelter. The Davis-Dunkirk mine, in the Senator district of Yavapai County, shipped five carloads of concentrates in December, valued at $100 per ton in gold and silver. To increase production of high-grade silver ore, a compressor and new electrical equipment are being installed.

The Hillside mine, known as the Lawlor property, has been purchased by H. L. Williams, of New York, who expects to build a 150-ton flotation plant there and to have it in operation by May 1. Mr. Williams and his associates have also acquired the Tillie Starbuck property, southeast of Prescott, and are developing it with a 2,100-ft. tunnel. The Delta mine, 7 miles south of Phoenix, is employing ten men, and is shipping two carloads of ore per week. The Comstock Dexter company has installed machinery and camp buildings at the General Minerals property, 5 miles south of the Hillside mine, and operations are to be started under the direction of T. F. M. Fitzgerald. C. M. Zander and R. M. Hanson have started up their 25-ton mill on

Annual Meeting of A.I.M.E. Feb. 19-22

The annual meeting of the American Institute of Mining and Metallurgical Engineers will be held in New York City at the Engineering Societies Building on Feb. 19-22. A well-rounded program, following the general plan of former years, has been prepared. Subjects to be discussed at the technical sessions include the following: aerial transportation, mineral dust hazards (silicosis), mining methods, mining geology, geophysical methods of prospecting, health and safety in mines, mineral industry education, nonferrous metallurgy, non-metallic minerals, ground movement and subsidence.

the Golden Eagle property near Slate Creek. A 25-ton custom mill on the East Verde River, 6 miles north of Payson, is treating ore for a number of Payson shippers.

In the Walnut Grove district of Yavapai County, E. N. Kelsey is operating a 10-ton pilot plant for Yavapai Gold & Silver Mining, which has taken over the property held for several years by Money Metals Exploration. About 10 miles south of Prescott, Oro Grande Mining has completed and placed in operation a 50-ton flotation mill on the Oro Flamme-Sterling group.

The Magma smelter, at Superior, resumed operation on Jan. 1. United Verde Extension copper production has dropped from 3,000,000 lb. per month to 2,500,000 lb. Tonnage mined has not decreased, the ore being mined is of lower copper content but higher in gold and silver value than that which was previously mined.

Michigan

The Michigan copper district, which is primarily a one-industry community, has been particularly benefited by the introduction of Civil Works projects, which are employing about 5,000 men in Houghton County and 800 in Keweenaw County. In the Calumet district, where Calumet & Hecla operates, 1,500 men are engaged in CWA work. This employment has greatly relieved the situation. No increase of mine payrolls can be expected before a decided upturn occurs in the copper market.

Because of the curtailed production at Copper Range, the company's Michigan smelter, at Houghton, has been idle for more than a month, concentrate is being accumulated, and when the smelter reopens it will operate full time until all of the concentrate on hand is converted into refined copper. Since the plant finished smelting the large accumulation of Mohawk mineral, the output of concentrate from the Champion mill of Copper Range has been insufficient to keep the smelter operating continuously.

A small force is being employed at the Ahmeek mine by Calumet & Hecla for maintenance purposes. Mining operations at the property were suspended in the spring of 1932 and will not be resumed until a demand exists for larger production.

Discovery on Western Rand Extends Mineral Area

A strike on the West Watersrand Areas seems likely to lead to extensive developments. Borehole E. 4 on Farm Driefontein, 21 miles beyond the Randfontein property, has disclosed a high-grade reef. Part of the gold seems to have been lost, as a portion of the core at a point where free gold was showing was not recovered. This reef was encountered at a depth of 3,610 ft., and is thought to be the south reef of the series.

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Cerro de Pasco Reopens Mines

Cerro de Pasco Corporation has resumed operations at its Casapalca mines, in Peru, which have been closed since 1931.

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Climax Molybdenum Expands

Climax Molybdenum, according to reports, plans to erect shortly a 2,000-ton addition to its milling plant at Climax, Colo.

California

Mountain Copper has taken an option on the Big Canyon mine, situated about 4½ miles south of Shingle Springs, Eldorado County, and is sampling the underground workings with the idea of purchasing and equipping the property should the results prove to be of a generally satisfactory character.

Drilling and sampling operations have been started at the tailing dump of Kennedy Mining & Milling at Jackson, to determine values, tonnage, and the methods to be employed for treating the material.

Milling operations have been started at the new 200-ton mill of Lava Cap Gold Mining. The mill serves as a central reduction plant for the Banner and Central mines, about 6 miles east of Nevada City.

Minnesota

Several mines started repairing their equipment early last month to be ready for open-pit operation by May 1, and to double last year's production, if necessary. The purchase of some new machinery is probable, as Butler Bros., who took over the LaRue mine last year, may move the ore more than a half mile by belt conveyor to the Shada mine washing plant, which they also acquired from the Clem Quinn Company. Such an installation would be the longest conveyor system on the range and a new departure from the old practice of locomotives and cars.

Texas

American Metal, owing to the higher price for newly mined silver, has resumed operations at its Presidio mine, near Shafter, Tex. The mine, idle since July, 1930, is one of the few in the "most nearly straight silver" classification.

United States Non-Ferrous Metal Production, 1932-1933

Copper, lead, and zinc in short tons; gold and silver in fine ounces

	Copper		Lead		Zinc		Gold		Silver	
	1932	1933	1932	1933	1932	1933	1932	1933	1932	1933
Eastern States	5,436	7,370	4,460	2,970	116,768	127,140	648	1,549	10,920	9,169
Central States:										
Tri-State district	.....	.....	18,131	26,790	90,660	138,050	.....	.....	.....	.....
Southeastern Missouri	.....	.....	116,152	85,100	40	.....	.....	.....	.....	.....
Upper Mississippi Valley	.....	.....	910	600	7,522	7,770	.....	.....	.....	.....
Michigan	27,198	23,790	.....	.....	.....	.....	.....	10	71,408	140,013
Other	.....	.....	35	390	46	240	(a) 479,324	(a) 508,629	(a) 146,102	(a) 163,883
	27,198	23,790	135,228	112,880	98,268	146,060	479,324	508,639	217,510	303,896
Western States:										
Arizona	91,246	56,250	1,182	1,150	.....	.....	66,666	48,955	2,137,259	1,419,842
California	709	570	1,209	350	.....	70	570,404	565,426	508,692	365,786
Colorado	3,699	4,970	2,150	2,260	109	1,250	270,131	249,581	1,653,084	2,139,635
Idaho	572	730	72,118	74,880	10,252	21,240	40,959	53,004	6,590,951	6,923,877
Montana	42,424	32,890	1,079	6,040	2,197	21,720	38,405	56,783	2,336,100	3,533,702
Nevada	15,744	19,450	440	2,370	127	5,830	127,530	100,422	1,305,062	948,168
New Mexico	14,210	13,630	10,114	10,770	25,593	31,360	20,008	26,016	1,108,164	1,214,282
Oregon	16	3	4	5	6	8	19,921	18,987	9,027	12,459
Utah	32,482	36,520	62,776	57,380	29,666	31,620	145,952	97,984	7,680,378	4,917,981
Washington	3	3	921	1,110	2,245	3,490	4,407	4,842	17,512	12,907
Wyoming	.....	.....	5	.....	.....	.....	1,650	2,206	298	346
	201,105	165,020	151,998	156,320	70,195	116,590	1,306,033	1,224,206	23,346,527	21,488,985
Alaska	4,369	13	1,261	1,520	.....	.....	433,193	418,332	256,673	154,602
Puerto Rico	.....	.....	.....	.....	.....	.....	106	29	12	2
Philippine Islands	.....	.....	.....	.....	.....	.....	229,728	282,336	149,131	184,476
Total	238,108	196,190	292,947	273,690	285,231	389,790	2,449,032	2,435,091	23,980,773	22,141,130

(a) Largely South Dakota.

Note: The copper, lead, and zinc statistics, issued by the U. S. Bureau of Mines, are for mine production, in terms of the recovered and recoverable metal content, with 1933 estimated. The gold and silver statistics, issued by the Director of the Mint, are for refinery production, as reported by the United States mints and assay offices and by private refineries; the 1933 figures are a preliminary estimate.

Personal Notes·Comment·Criticism

A. Chester Beatty is spending his winter vacation in Egypt.

Sydney H. Ball, of Rogers, Mayer and Ball, is in Cuba on professional business.

Dr. J. S. Gould and **M. B. King** have been appointed labor advisers of the NRA.

E. L. Stenger is now mine superintendent at the Sheep Tanks mine, Vicksburg, Ariz.

G. R. MacLaren has been appointed superintendent of the Paymaster mine, Porcupine, Ont.

G. A. Joslin has returned to Los Angeles after a six months' examination trip in Mexico.

W. R. Crane has recently gone to the Pacific Coast, where he will make his residence at Berkeley, Calif.

A. W. Allen, who recently returned from London to New York, has left for Oregon, on metallurgical work.

Edwin K. Chase, metallurgical engineer, is now located at 1052 Subway Terminal Building, Los Angeles.

Charles A. Ordway will be in Mexico for two weeks this month, making an investigation of a gold mine.

Henry C. Carlisle, consulting engineer, San Francisco, has gone to British Columbia on professional business.

Newton Cleaveland, president, Yuba Engineers, Inc., is in Gold Creek, Montana, directing the erection of a dredge.

Mrs. William Boyce Thompson, widow of Colonel Thompson, has been elected to the board of the Newmont Mining Corporation.

Robert A. Kinzie, consulting engineer to the Santa Cruz Portland Cement Company, has been in New York and other Eastern points on business.

S. M. D. Clapper has been elected president of the General Refractories Company, succeeding **John R. Sproul,** who recently resigned.

Howard S. Drullard has returned to San Francisco after an extensive trip through Utah and Montana studying current rock-drill practice.

R. G. Crossle, of Melbourne, Australia, will sail from San Francisco on Feb. 14, after a visit of several months in the United States and Canada.

Clinton H. Crane, with Mrs. Crane and Miss Rebecca Crane, sailed from New York for Italy on the "Conte di Savoia" on Jan. 20.

J. A. Swart, recently with the Mesabi Iron company at Babbitt, Minn., is doing engineering work for the U. S. Geological Survey at Quartzite, Ariz.

Anton Gronningsaeter, of the Falconbridge Nickel Company, has arrived in New York from the company's refinery, in Norway, for a four months' stay.

C. W. Plumb has retired from his position with the Consolidated Copper & Sulphur Company, Eustis, Quebec, to take charge of a property in California.

Guy C. Riddell, mining engineer of New York City, is at the National Hotel, Moscow, where he arrived on Jan. 18. He will be in Russia for several weeks.

Sir Auckland Geddes, chairman of Rhokana Corporation, Ltd., has returned to London after a prolonged visit to the company's properties in Northern Rhodesia.

S. S. Taylor and **L. A. Pollak,** managing directors of Rhokana Corporation, Ltd., left London early in January to visit the company's properties. They traveled by air.

Robert William Wilson has assumed the position of general mine superintendent for the Cia. Unificada del Cerro de Potosi at Potosi, Bolivia.

C. C. Doyle, until recently chief mine engineer for the Avalos unit of Cia. Minera de Peñoles, is now a postgraduate student at the university of Arizona.

H. W. Gould, consulting mining engineer, Gould & Company, was recently in New York and Washington, D. C., in connection with mining business on the Pacific Coast.

Lawrence W. Wallace, formerly executive secretary of American Engineering Council, has become associated, as vice-president, with the W. S. Lee Engineering Corporation, Washington, D. C.

Frank Ayer, general manager of the Roan Antelope property at Luanshya, Northern Rhodesia, is now also supervising operations of Mufulira, which recently started production.

Harry D. Hunt has resigned as mill superintendent for Miami Copper to accept a position with Newmont, and will be located at Empire, near Jellicoe, 150 miles north of Port Arthur, Ontario.

W. K. Leach, formerly with the General Alloys Company, of Boston, is now associated with the American Manganese Steel Company as general manager of the alloy division of the company.

Thos. M. Kekich, who for the last forty years has been connected with importing mining and smelting companies in the United States and abroad, recently joined the staff of the California Smelting & Refining Company.

L. K. Fletcher has in hand for Bobjo Mines, for which he is consulting engineer, an interesting gold development at Temagami, just south of the Cobalt silver area. The vein material is arsenical and was considered of too refractory a nature to be of interest when it was discovered, thirty years ago.

H. A. Kee has been appointed manager of the Sullivan gold mine, in northern Quebec, where he has made preparations to install a 50-ton cyanide mill. Last year Mr. Kee installed and put in operation the Greene-Stabell mill, near the Sullivan.

J. B. Knaebel, until recently acting supervising engineer, U. S. Bureau of Mines, has left for the Philippines, where he will assume charge of a gold property in the southern part of the archipelago. His address is care of A. F. Duggleby, Box 817, Manila, P. I.

W. B. Gohring, of Phoenix, has been appointed State civic works engineer for Arizona. **Thomas Cowperthwaite,** of Warren, has been appointed civic works safety director, and **Charles Cunningham,** of Douglas, has become civic works purchasing agent for Arizona.

E. N. Pennebaker, chief geologist for Consolidated Coppermines Corporation, who recently completed five months' geological investigation near Mountain City, Nev., for the E. C. Congdon interests, of Duluth, Minn., has returned to his post with Coppermines, continuing the corporation's geological work near Ely, Nev.

Malcolm Muir, who since the formation of NRA had been Divisional Administrator of the National Recovery Administration, has resigned from the federal service to resume his post as president of the McGraw-Hill Publishing Company. Under Mr. Muir's direction 110 codes have been agreed upon and signed by the President.

R. N. Palmer, who formerly managed mines in the Sudbury district and latterly has contracted for shafts in the Pennsylvania anthracite field, has acquired the McKellar-Longworth gold property, near Schreiber, on the north shore of Lake Superior, where he is developing several narrow, high-grade veins with a view to installing a small mill.

Oliver Hoare has returned to London from Stockholm, where he has been negotiating on behalf of Consolidated Goldfields of South Africa for the purchase of a majority of the shares of Boliden Mines. **M. Lindeberg,** administrator of the Kreuger and Toll estate, says no option on the property has as yet been given, but that negotiations have not been broken off.

C. N. Schuette, of San Francisco, appeared before the U. S. Tariff Commission last month on behalf of the National Quicksilver Producers' Association, seeking relief, under the import limitation clause of NIRA, from foreign dumping of quicksilver in the domestic market. Other representatives of the industry at the hearing were **H. W. Gould, W. R. Morehead,** and **Irvin Ballard.**

M. W. von Bernewitz recently visited the Thames and Waihi gold districts and the Huntley coal field, North Island, New Zealand, and has returned to Sydney after a rail trip of 5,000 miles to Kalgoorlie, Western Australia, and Broken Hill, New South Wales. He reports that a great revival continues in the production of gold and that the lead-silver-zinc mines are surprisingly busy.

L. M. Robinson has been appointed mine superintendent for the Suyoc Consolidated Mining Company at Baguio, P. I. A graduate of the Texas School of Mines, class of 1923, Mr. Robinson was chief underground transit engineer at the Old Dominion mine, at Globe, and was later employed by the Christmas Copper Company before going to the Philippines as mining engineer for Itogon Mining.

R. M. Macaulay has taken over the direction of the Bussières mine on behalf of Quebec Gold Mining Corporation, of which he is vice-president. The Bussières is the gold property developed by the late F. W. Bradley in geological surroundings that had baffled other mining men. Its success has stimulated the development of several other deposits of somewhat similar type and has extended considerably the areas considered to be definitely favorable for gold prospecting.

Frederick M. Feiker, formerly editor and chairman of the board of the A. W. Shaw Company, of Chicago, and editor and vice-president in charge of editorial policy of the McGraw-Hill Publishing Company, and recently director of the Bureau of Foreign and Domestic Commerce in the Federal Department of Commerce, has been appointed executive secretary of American Engineering Council, with headquarters at 744 Jackson Place, Washington, D. C. Mr. Feiker has already assumed his new duties.

W. P. Alderson is now developing two gold properties for the Montreal group he represents in central Africa. At a distance of 8 miles from the east shore of Lake Victoria, in Tanganyika, a wide mineralized zone with consistently good surface values is now being tested underground from two shafts 500 ft. apart. The rocks are of Pre-Cambrian age, much like those of the gold areas of northern Canada. The elevation is 4,000 ft. and the climate is good. West of Lake Victoria in Uganda a placer deposit is being prospected by sluicing. **A. A. McMartin,** who returned to Montreal just before Christmas, will rejoin Mr. Alderson at the end of February.

James O. Greenan has resigned as general superintendent of the Benguet Consolidated Mining Company at Antamok, P. I., and has accepted a position as consulting engineer and geologist with Marsman & Company, operating the Itogon, Suyoc Consolidated, and Paracale properties. Greenan received the appointment as general superintendent of the Benguet mine in 1929, going to the islands from Nevada. **Walter James Pike,** a member of Greenan's operating staff, has gone with the Baguio Gold Mining Company as mine superintendent. The properties adjoin but are operated by independent companies, both with headquarters at Manila.

OBITUARY

Frank Conroy, mining engineer, at Asheville, N. C.; aged 74.

Walter J. Yarrow, geologist; at Tulare, Calif., on Jan. 17; aged 59.

Charles J. Eastman, Tombstone pioneer; at Casa Grande, Ariz., on Jan. 13; aged 77.

Dr. Warren Upham, archeologist and geologist, at St. Paul, Minn., on Jan. 29; aged 83.

Robert T. Shillington, who played a prominent part in the development of the Cobalt camp; in Toronto, on Jan. 11.

Robert Sisson, Copper Queen pensioner, who had lived in Bisbee for over a quarter of a century, in Bisbee on Oct. 13.

Sir Evelyn Ashley Wallers, K.B.E., long associated with mining on the Rand, at Highfield Park, Hertfordshire, England; on Jan. 5; aged 57.

William Martell, engineer at the Kennedy mine at Jackson, Amador County, Calif., for 25 years, died recently while on duty, from heart disease; aged 48.

Colonel Manuel Herrara de Hora, mining engineer, soldier, traveler, and a colorful adventurer in many parts of the world; at New York, on Jan. 26; aged 84.

Donald McRuer, Phoenix mining engineer and manager of the Rosenberg Machinery Company, in Phoenix on Nov. 5, aged 65. He managed the Rowley Copper Company, of Gila Bend, for ten years.

Bertram Ashley, well-known Ontario prospector, who discovered the Ashley gold mine, was drowned with a companion in Lake Ontario on Dec. 10th, when his airplane failed on an attempted flight from Toronto to Fort Erie.

John Rhodes Roberts, engineer revenue agent, United States Bureau of Internal Revenue, at San Francsico; aged 45. Mr. Roberts was a graduate of the University of Wisconsin and an active member of the San Francisco section of A.I.M.E.

Nelson Baker, at Salt Lake City, Utah, on Dec. 13; aged 62. Mr. Baker had been master mechanic at many properties in Utah, Nevada, and Idaho. He retired twelve years ago to his home in Salt Lake, where he resided up to the time of his death.

Thomas Lawrence Walden, manager of New Park Mining, at Salt Lake City, Utah, on Aug. 13; aged 68. Mr. Walden had been associated with the development of the Park City and Tintic districts for more than forty years.

A Tribute to Charles Butters

The Editor:

I just received the December issue of *Engineering and Mining Journal* and it was with deep regret that I read your notice of the passing of that grand old man of the metallurgical world, Charles Butters. It touches me personally, as I was employed by Mr. Butters over a long span of years; first in 1909 at Butters Copala Mines, at Copala, Sinaloa, being sent from there to the Butters Divisadero Mines, at Divisadero, Salvador, Central America, and later I was employed at his aluminum dust plant when it was in its beginning at Chabot Road, Claremont district, Oakland, Calif.; and I was operating a small gold property at Cacamuyá, on the border of Honduras and Nicaragua, about 24 miles from the Butters Gracia Mine, just a short time before it was sacked by the notorious bandit, Sandino. The trip across Nicaragua to San Juancinto, Honduras, was mostly on the hurricane deck of a mule, and it was some achievement for a man of Mr. Butters' age at that time, the latter part of 1925.

My dealings with Mr. Butters were always of the most pleasant, and he will always be cherished by my family and myself as a sincere friend. We feel that we have lost a friend; likewise a deep loss to the mining world has occurred by his passing. ERNEST A. NICOLAI,
Foreman, Surcease Mine.
Butte County, Calif.

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McIntyre Metallurgy

The Editor:

I have read with much interest the admirable articles in your November issue entitled "The Story of McIntyre." One point in particular seems to stand out sufficiently to warrant comment, although I doubt not that a management as efficient as that of McIntyre Porcupine Mines, Ltd., is fully aware of the conditions. I refer to the inadequacy of screens and rolls as indicated by the screen analyses given in Table III on page 476.

Column 4 shows 20.9 per cent (or by computation from Column 3, 13.47 tons) of minus 4 mesh being rejected by the screens and returned to the rolls out of every 49 tons of minus 4 mesh in the screen feed. Upon the basis of screen reject, the screening efficiency is 79.1 per cent, and upon the basis of removal of all possible fines it is but 72.5 per cent. Neither of these is what it should be for best mill efficiency.

Comparing Columns 4 and 5, it is seen that out of each 100 tons of plus 4 mesh in the roll feed, only 28 tons is reduced to minus 4, requiring recirculation of 72 tons over the screens and through the rolls, with resultant waste of power in a number of places. G. F. DODGE.

The Editor:

Referring to Mr. Dodge's letter on crushing and screening efficiency at the McIntyre, I may say that his calculations of the screening efficiency as indicated by sizing analysis in Table III, page 476, are quite correct, assuming, of course, that the point of separation and economical crushing with rolls is at 4 mesh. On the other hand, calculation of screening performance using 6 mesh as the point of separation shows better than 90 per cent.

Our experience proves that it is an advantage to reduce the plus 6-mesh material in the rolls, as this method of reduction is cheaper than tube milling; therefore I do not think it is fair for Mr. Dodge to judge the efficiency of the unit strictly on a 4-mesh basis.

As will be noted on page 472, the composition of McIntyre ore consists of quartz, porphyry, and schistose basalt and dacite. The quartz breaks down fairly uniformly, but the schistose material has a tendency to splinter, thus giving a product which is long in one dimension; and in making sizing analyses it is difficult to

assign these particles to any given mesh. In view of this condition, a "near mesh" product is obtained, which necessitates the carrying of a high circulating load.

Mr. Dodge is in error in stating, in his final paragraph, that out of each 100 tons of plus 4 mesh in the roll feed only 28 tons is reduced to minus 4 mesh. I believe what he meant to say was, out of each 100 tons of roll feed, and not plus 4 mesh.

J. J. DENNY.

Electrodeposition of Copper Sheets Not New

The Editor:

As a regular reader of your well-informed journal I was surprised to read in your July issue an article on electrodeposition of copper sheets by Mr. B. H. Strom in which it was stated that:

"Production of sound metallic sheets by electrodeposition is an accomplishment long desired by copper refiners. Many obstacles have prevented the realization of this attainment and no commercial production was attempted until the Raritan Copper Works . . . . "

I should like to point out that:

1. The production of perfectly sound electrolytically deposited copper sheets has been an accomplished fact in France and Switzerland since 1920.

2. The process has been and is being worked on a commercial scale in France and Switzerland.

3. I personally imported into England these sheets as far back as 1929.

The process is simpler than the one described by Mr. Strom, it being carried out in one operation, the sheets produced being 8 square meters and 15 square meters in area and of any gage from 0.1 millimeter to 3 millimeters; also strip 30 to 40 meters long.

These sheets, owing to their physical characteristics, are specially adapted for roofing, almost all of the most important Swiss Federal Railways stations having been covered with them.

It might be of interest to note that when I first introduced these sheets in England I had the greatest difficulty in convincing the buyers that these sheets had not been rolled at all.

ROBERT H. D. BLATTNER,
A.R.S.M., A.I.M.M.

East Sheen, England.

The Editor:

Information regarding the production of copper sheet by electrolysis has been very difficult to obtain, and this has naturally led to the conclusion that production must be quite limited. Mr. Blattner is unquestionably correct in his statement that sheets of excellent qualities have been produced before; I have personally had the opportunity to examine one piece of such material, of extra heavy gage, made over ten years ago. The difficulty has been, however, that for such heavy gages the process has offered no advantages over the regular rolling methods.

The important point about the material described in my article is that this copper is produced in continuous strips of any desired width, in the thinner gages which cannot be produced by rolling, and at a cost comparing favorably with that of the heavier rolled material.

B. H. STROM.

New York City

Again Tellurides

The Editor:

The recent articles and discussion on tellurides were interesting. We are engaged in opening up a mine that should shed some light upon the problems of tellurides. The property (Associated Metal Mines) is in Boulder County, Colo., and probably contains more tellurium than any other yet investigated. The ore is high in tellurium, always containing some gold and small amounts of silver, but the tellurium is far in excess of that required by the gold content. It is so high that the ore will not roast and leave the free gold as Cripple Creek ores do. Whereas, specimen pieces of Cripple Creek ores roast easily in almost any fire, we have not been able to roast out the free gold in a specimen running better than 1,000 oz. to the ton. Iron sulphides (pyrite and marcasite) are the only base-metal sulphides thus far identified.

Milling awaits further mine development. Shipments to date consist of small lots of sorted ores sent to custom plants for mill testing and better valuation than can be had by assaying. The ore is difficult to sample and assay, as is shown by the fact that on one shipment the ore buyer and the umpire assays varied by 13 per cent. Indications are that flotation will make a good recovery at a high ratio of concentration. Cyaniding of the concentrates should give some interesting data on tellurides.

JOHN H. WILSON,
Denver, Colo. Metallurgical Engineer

Mexican Immigration Laws Impose Difficult Conditions

The Editor:

The writer has been a subscriber for many years to *Engineering and Mining Journal*. Recently he and some of his associates formed a small syndicate for the purpose of investigating several mining projects in Mexico. The one and only property investigated by our engineer was a gold mine located in the Sierras about 70 miles from the nearest railroad point. The engineer's report was favorable, but he did not recommend the venture—for two reasons. First, there was a lack of skilled labor in the vicinity; and, second, the present stringent passport regulations in Mexico make it difficult to bring in skilled men to train what labor is available.

We then instructed our engineer to get technical advice on the passport situation before we decided definitely to abandon the project. He reported that the Mexican immigration laws are designed to prevent foreigners doing work in Mexico that can be done by people residing in that country. This would mean that we could not select a staff until we could prove conclusively that the work could not be done by people now residing in Mexico.

He reported that there are three classes of passports: tourist's, temporary working, and resident passports.

The tourist's passport is easily obtained from the nearest Mexican Consul, but if the bearer of this form of passport performs any work in Mexico, he is subject to fine and deportation from the country.

The temporary working passport, or special permit for six months, is granted when a bond for 250 pesos is given to the Mexican Government, to be cancelled upon the return of the person to his own country. This passport can be obtained only through the Immigration Department in Mexico City, and the time required varies from ten days to two months, depending upon the ruling of the immigration authorities as to whether the proposed work can be done by residents of Mexico. The cost of this bond is from 20 pesos upwards.

The resident passport is used on a showing that the applicant has a legal residence in Mexico and has invested over 10,000 pesos in that country. This is granted only after one has satisfied the Immigration Department of his good reputation and ability to support himself. If the holder of such a passport leaves Mexico for a period of more than six months the passport is cancelled unless, on his departure, he procures and fills in two blanks, one of which is deposited as he leaves the country and the other given up on his return.

Foreigners who desire to invest money in Mexico, or who already have investments there and wish to make occasional trips into the country to look after their interests, are confronted wih a serious problem. Do they wish to establish a legal residence in Mexico? Shall they incur the delay, trouble, and expense of securing a special permit for six months every time they visit the country? Or shall they enter on a tourist's passport good for six months, with the attendant penalty that is involved if they perform any work?

The investor who supplies the capital for a project in Mexico feels that, if he cannot secure a suitable manager and heads of departments in the locality of the proposed investment, except for a period of six months, he would be very dubious about his ability to secure such men in other parts of Mexico, even though it is represented that plenty of them are available.

One of our syndicate owns mining claims in Mexico, has paid pertinencia taxes on these claims for many years, and has over 10,000 pesos invested. After studying the report of our engineer he is in a quandary as to what he shall do, inasmuch as he wants to spend money on development work and probably direct this work personally. Shall he take out the necessary papers for legal residence in Mexico, with privilege of six months leave of absence from the country? Shall he obtain a special permit for six months every time he wishes to go to Mexico, putting up a bond and incurring the attendant delays in Mexico City? Or shall he take out a tourist's passport and lay himself liable to fine and deportation if he does any manual labor such as cutting samples or digging trenches on his claims?

We understand the Mexican Government is desirous of interesting foreign capital in mining ventures in Mexico, and we would welcome any suggestion you may have to offer by which the difficulties of securing suitable management on a new project can be overcome.

New York, N. Y. MINING ENGINEER.

EDITOR'S NOTE. Although this communication is not signed personally, the author is known to us as a reputable engineer. Correspondence is invited from other engineers who may have had a similar experience, or who may be affected by the conditions indicated.

BOOK REVIEWS

The Lindgren Volume

A Review by Dr. Charles P. Berkey

ORE DEPOSITS OF THE WESTERN UNITED STATES. *Edited by a committee headed by John Wellington Finch and published by the American Institute of Mining and Metallurgical Engineers. Pp. 930. Price $6.50.*

This unique and valuable volume is dedicated to Waldemar Lindgren "by his professional peers as an expression of their appreciation and admiration." It is avowedly designed primarily as a tribute to a man, in particular to the most widely productive and constructively influential contributor to American economic and mining geology. It will be recognized everywhere as a fitting form of recognition of many years of lasting services to geologic science and to wisely directed development of mineral resources.

This would be sufficient reason for the large combined effort and extremely creditable product represented by this volume. But, in addition, it is a remarkably effective contribution to the same field on its own account. No one really concerned in either a theoretical or practical way with mineral resources can afford to overlook its 784 pages of solid instruction. It constitutes the most up-to-date and authoritative reference in English on the general subject of ore deposits and the great American ore fields.

In the space allotted one cannot review this large volume. Too many features deserve special comment. In attempting to do justice to a few there is danger of slighting others of like value. Its long succession of fifty individual contributions from more than forty authorities, together with the broad sweep of the subject-matter, makes that task too heavy. Here one may find biography and history as well as matter-of-fact description, and theory or speculation on the borders of the unknown as well as practical application, and review of principles concerned with ore genesis as well as discussions of the meaning of the deposits themselves—all as seen by and vouched for by men who have reason to know.

This volume is not in any sense a text, and yet it will serve the purposes of instruction in many ways and in many places. It will be especially useful to those already well launched in the professions of geology and mining. It will be invaluable to anyone who needs a convenient reference on the development of Western geology and its application to mining, or one who wishes to true up on principles of classification of mineral deposits, or more specifically on the physico-chemical factors involved in deep-seated processes, or on hydrothermal depth zones, or magmatic differentiation, or the significance of batholiths, or on structural relation and distribution of orebodies, or on the relation between kinds of rock formations and kinds of ores, or special discussions of particular genetic types or groups of deposits—all of these and more like them in importance and suggestiveness assembled here in convenient form for ready use.

These men and the Institute, in assembling and issuing this Lindgren volume, have performed a real service, and for it deserve a word of appreciation. It is a big undertaking very well done, an appropriate tribute and a most creditable offering.

For those who may be concerned only with its utility, the book meets every legitimate desire. For those others, perhaps no less practical, who have faith also in the so-called immaterial things, this volume stands for the highest rewards that come to men—recognition of superior service, appreciation of the work of a long life, and affectionate regard.

Porphyry History

THE PORPHYRY COPPERS. *By A. B. Parsons. American Institute of Mining and Metallurgical Engineers, New York. Pp. 600. Price $4 to nonmembers; $1.50 to members (one copy to a member).*

In a foreword to this volume John Hays Hammond makes this significant statement:

"No one who wishes to understand the history of this country, or indeed the industrial development of the world since the beginning of the century, can afford to neglect this story."

In the opening chapter, entitled "An Achievement of Engineers," Mr. Parsons estimates the value (gold) of that achievement, through its reduction in the cost of producing copper, at $250,000,000 per annum. Without attempting to analyze the accuracy of this estimate, with which I find myself in substantial agreement, I wish to point out that this saving of 6c. per pound in the cost created a revolution in the copper industry. Failure to recognize its significance has played a major part in the present widespread demoralization of the industry.

To appreciate this one need merely recall the fact that the average margin of profit earned by the industry had been about 4c. per pound prior to the achievement conceived and accomplished by that distinguished group of engineers headed by Colonel D. C. Jackling, who have been responsible for the development of the porphyry coppers. The attempt to add all of the saving to profit by maintaining artificially a price level having no proven relationship to the new level of cost is the real cause of the present overdevelopment of the industry.

In the field of engineering, having once learned to do something in a better and cheaper way, the world has never lost that knowledge, but in the field of economics it seems unable to remember even from one generation to the next what it has learned.

Mr. Parsons has ably performed a valuable service in recording the story of this achievement. It is to be hoped that its implications will not be lost on the coming generations of boards of directors of industry. It will never be forgotten by the engineers.

ARTHUR NOTMAN.

Essays on Recovery

ECONOMICS OF THE RECOVERY PROGRAM. *By Seven Harvard Economists. Whittlesey House, McGraw - Hill Book Company, New York, 1934. Pp. 188; $1.50.*

This collection of essays critically considering the recovery program begins with a discussion (by Joseph A. Schumpeter, formerly Austrian Minister of Finance) of depressions in general. He concludes that the present one is not different in kind and not much different in phenomena, that recovery always has come of itself, and that while it is futile to hope for miraculous cures to take place, it would be equally unwise to do nothing.

Edward Chamberlain, author of "The Theory of Monopolistic Competition," next considers purchasing power. What is usually meant by this is income; invested savings from incomes are as truly spent as the money paid out for food and rent. A high wage rate does not cause a corresponding increase in real income unless there is no corresponding increase in prices accompanying it.

Edward S. Mason, author of "The Street Railway in Massachusetts," discusses NIRA as (1) a means of eliminating unfair competition, (2) a scheme for regulating output and prices, and (3) a substitution of planning for unregulated individualism. It is impossible to summarize, beyond saying he thinks NRA probably will not be able to do any better with some problems than we have done, code provisions may prove difficult or impossible to enforce, while others are likely to produce results contrary to those aimed

at and prove a menace to both recovery and reform. He thinks we have as yet no adequate technique for planning.

Douglass V. Brown, a specialist in labor relations, next takes up unemployment relief, sharing of work, public works (which he thinks no panacea), labor provisions of the codes, and related subjects. His general conclusion seems to be that it is just now more important to get men employed than to try to improve labor conditions.

S. E. Harris, author of "Twenty Years of Federal Reserve Policy," treats of higher prices, which may be brought about by (1) restricting production, (2) transfer of purchasing power from non-spenders to spenders, and (3) creating of additional purchasing power through the banking system or government printing presses. This may best be summarized by noting that Mr. Harris believes that the price of a dollar in francs is affected by many factors besides the amount of gold which the dollar represents.

W. W Leontief, formerly economic adviser to China, discusses mortgage relief, reduction of agricultural output, direct bonus payment, and taxation of farm products as means of helping the farmers. He finally raises the question as to whether the aim is to reëstablish the old relation between (1) the price levels of agricultural and industrial goods, (2) the aggregate incomes of the total agricultural and industrial populations, or (3) the rate of remuneration of capital and labor in industry and agriculture, pointing out that they cannot be simultaneously obtained.

O. H. Taylor concludes with a discussion of economics versus politics in which he says: ". . . Economic realism must recognize that, in our present situation, the common interest of all in a general recovery of honest business, agriculture, and employment is most endangered by the power, strategy, and economic illusions of the discontented classes; by the passion for reform that indiscriminately attacks, along with real abuses, the normal practices and gains of honest economic competition; and by the fallacious economic theories or fallacious views of the way to recovery for all, which are rationalizations of the rival demands of different groups in distress."

For the many who have neither time nor facilities to consider all these problems this concise book will be most valuable.

T. T. Read.

Geophysics

More of Gutenberg's Handbook

Handbuch der Geophysik. *Edited by B. Gutenberg. Gebrueder Borntraeger, Berlin. Prices as stated in the following:*

Band IV, Lieferung 4. Pp. 195, 49 figures. Die seitliche Folge der Erdbeben und bebenausloesende Ursachen. By V. Conrad.

Band II, Lieferung 3. Pp. 236, 62 figures. Price Rm. 42. Die Erdoberflaeche; by E. Kossinna. Petrographischer Aufbau der Erdkruste; by S. Roesch; Chemie der Meteoriten, G. von Hevesy.

Band VII, Lieferung 1. Pp. 252, 54 figures. Price Rm. 42. Das Eis der Erde; by H. Hess. Seen (Lakes); by W. Halbfass. Das unterirdische Wasser; by W. Koehne.

With the exception of the first of these latest volumes of the "Handbuch der Geophysik," the contributions are largely geological in nature. In the first volume, dealing with the periodicity of earthquakes, the author reviews possible agents which may release earthquakes, such as variations of temperature, pressure, precipitation, tides, and of movements of the pole. In the main part of the book, a tremendous amount of earthquake observations is analyzed. Whenever possible, mathematical methods of investigations into the reality of periods are stressed. The fore- and aftershocks of individual quakes, and the annual and diurnal periodicity of quakes, are thus treated. In the third part of the book the author discusses agents likely to release earthquakes and concludes that an influence of load gradients produced by precipitation appears pronounced, that an influence of marine tides is probable, but an effect of bodily tides has not been proved. A relation between the earthquake periodicity and the Chandlerian period of pole movement is probable, but no such relation exists between earthquake periodicity and sunspot period.

The first part of the second volume, written by Kossinna, deals with the general horizontal and vertical distribution of elevations in the topography of the earth's crust. Of interest is a depth chart of the Atlantic Ocean, based partly on acoustic depth determination made by the vessel "Meteor." Unfortunately, the manuscript was completed in October, 1931, and new depth determinations in the Atlantic and Pacific oceans recently published by various oceanographic institutions could not be included. In the section entitled "Petrographic Constitution of the Earth's Crust," S. Roesch first deals with the distribution of chemical elements in the various shells of the earth's interior, in the atmosphere and hydrosphere. Then follows a lucid explanation of the principles of mineral chemistry and of petrology, covering such topics as classification, form, and texture of various types of rocks. The concluding portion is devoted to a detailed discussion of igneous, sedimentary, and metamorphic rocks, their composition and occurrence in the crust. In the third section, G. von Hevesy discusses the chemical composition of the various types of meteorites and the conclusions to be derived in regard to the earth's interior.

The first section of the third volume deals with glaciology; the other two discuss hydrology. In the first part, Hess discusses the physical properties and the various forms of ice. The remainder is devoted to a detailed treatise on glaciers. The second section deals with lakes and has been written by W. Halbfass. Their geographic distribution, geologic origin, morphology, optics, and chemistry hydrology are briefly treated, while more space is devoted to discussion of their hydraulic and thermal behavior.

The last part, which is written by W. Koehne, deals with a subject of interest to geologists and geophysicists—namely, groundwater. The treatment is largely confined to the dynamics of groundwater; that is, the laws which control its movements. The author discusses first the circulation of groundwater and effects produced by the gradient as well as the permeabilities of the more common strata. Wave motions in groundwaters, and the movement of water due to capillary action are also considered.

C. A. Heiland.

The Mineral Inquiry

Elements of a National Mineral Policy, *Prepared by the Mineral Inquiry, C. K. Leith, chairman; H. Foster Bain and S. M. Marshall, editorial committee. Engineering Societies Building, New York. Pp. 162. Price $1.25.*

A series of discussions of various points involved in the consideration of the elements of a national mineral policy, as outlined by Dr. C. K. Leith, is here presented. The general statement of Dr. Leith is reprinted; likewise the survey of control of principal minerals by world powers, by W. P. Rawles, secretary of the Mineral Inquiry. Both of these have previously been reviewed. The other individual contributions and their respective authors are: "Effect of Nationalistic Ambitions Upon Coal-Mine Capacity and Coal Trade in Post-War Europe," W. H. Voskuil; "Bituminous Coal Mining and the Appalachian Coals Case," H. N. Eavenson; "Mineral Trade, Exchange and Security," C. T. Duce; "Influences of National Planning," S. M. Marshall; "International Aspects of the Mineral Industry," Arthur Notman; "Centralized Planning Needed," J. E. Orchard; "Open-Door Policy of Mineral De-

velopment," J. W. Frey; "Productivity and Protection," T. T. Read; "Some Possible Reciprocal Adjustments," J. W. Furness; "Competition or Control in the Base-Metal Industry," Alex. Skelton; "Mineral Policy and Economic Nationalism," C. Reinold Noyes; "Influence of Technology on Control of Production," D. F. Hewett; "Notes on the Attempted Stabilization of Copper," P. E. Barbour; "Some Economic Aspects of a National Mineral Policy," R. S. Tucker; "Economic Motives Versus Economic Nationalism," H. K. Norton; "United States Oil Industry," Earl Oliver; an anonymous contribution on "National Defense and Minerals"; and "Manganese and National Defense," Charles M. Weld.

A TEXTBOOK OF FIRE ASSAYING. *Second Edition. By Edward E. Bugbee. John Wiley & Sons, Inc., New York. Pp. 292. Price* $3, *plus postage.*

Differences between this and the first edition (1922) consist chiefly in the inclusion of the following additional material—namely, a 42-page chapter on the assay of ores and products containing metals of the platinum group, this at the end of the book; 1½ pages on testing barren solutions for gold, in the chapter on the assay of solutions; and 2 pages on the assay of ores and products containing bismuth, in the chapter on the assay of complex ores. Two pages on "slags for alumina" have been rewritten, and, in the chapter on cupellation, two tables presenting data on the respective effects of copper on gold and silver losses in cupelling have been changed. The information presented on the assay for the platinum group should be of some help to those assayers who at times have reported the occurrence of platinum in generous quantities in samples that really did not contain it. As a textbook, the work is admirable in that the author endeavors throughout to make the student understand the underlying reasons for what he does.

GEOLOGY OF CALIFORNIA. *By Ralph D. Reed. Published by the American Association of Petroleum Geologists, Tulsa, Okla. Pp.* 355. *Price* $5, *postpaid.*

Mr. Reed's objective has been to furnish a sketch of the stratigraphy, structure, and geologic history of California; to emphasize some major unsolved problems of its geology; and to supply an introductory account of the status of geological work there. While much accurate information of the sort needed for an adequate interpretation of problems of regional geology and geologic history has been obtained in the last 30 years, he says, less attention than before has been given to the broader aspects of these problems, with the result that the geology of the State has come to seem more complex and disconnected than before.

A New Book on Metallurgy

PRINCIPLES OF METALLURGY. *By Donald M. Liddell and Gilbert E. Doan. McGraw-Hill Book Company, New York. Pp. 626. Price $5.50*

The authors, by careful selection and arrangement of material, have endeavored to cover and exemplify their subject with simplicity and precision, and to avoid those details that might be confusing or unessential. In many metallurgical processes, details of procedure are continually changing, and descriptions that are too well defined at present may be misleading at a future date. This fact should be borne in mind by the specialist who may find fault with the treatment accorded his pet phase of the subject in this volume. An attempt to cover the principles of metallurgy in a volume of 600 pages may seem overly courageous to the engineer searching for a single book containing solutions to all the problems he may encounter. No one book or set of books will suffice for the specialist when he has to go to the heart of certain problems, and yet a brief outline of the basic principles and their applications, in some field of the subject apart from his specialty, will often prove adequate for his immediate requirements. When necessary, the metallurgist who knows how to apply his knowledge of mathematics and physical chemistry can utilize basic formulas and principles and derive data found in voluminous tables, with sufficient accuracy for practical purposes. Tables save time only when readily available and when their relation to the principles involved is thoroughly recognized.

Preceded by a brief introduction covering the history and economic aspect of metallurgy, the material is divided into three parts: I, Materials Consumed in Metallurgy; II, Extractive Processes and Apparatus; III, Physical Metallurgy. Part I covers Ores, Slags and Fluxes, Refractories, Fuels, and Air and Water Supply. Ores are classified according to their chief characteristics and the influences of the latter on the economic methods of treatment are exemplified. Simple classifications are given for the various types of fluxes and slags, and the basic principles underlying the use of fluxes and formation of slags are linked to the requisites thereof, in each case. Tables of combustion data, heats of combination, oxygen and air required, and theoretical maximum temperatures are much condensed.

The first chapter in Part II is devoted to Ore Preparation, the treatment being purely non-mathematical. No involved theories or equations appear, but both general and particular principles are outlined, and the chief types of equipment used are described. The second chapter, Pyrometallurgical Processes, covers the subjects of Roasting, Smelting, Thermochemistry, Refining, and Distillation and Condensation. Roasting is discussed in a comparatively comprehensive manner. Smelting and its principal objectives are concisely defined, with an outline of the principles involved, and the most important solubility diagrams applying to it are given as illustrations. The discussion of Thermochemistry is illustrated by Guertler-Leitgebel diagrams showing the heats of formation of the oxides, sulphides, and chlorides of the metals. In treating the topics under the head of Refining—namely, Fire Refining, Converting, and Electrolytic Refining—general principles rather than specific details are dealt with except in reference to iron. Distillation and condensation are treated briefly, with reference mainly to zinc refining.

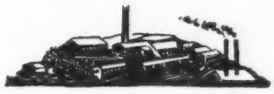
The third and fourth chapters in Part II are devoted to Hydrometallurgy and Electrometallurgy. In them the general description of apparatus and equipment follows, and is carefully separated from, theory and outlines of particular processes. Much confusion as to these processes has possibly arisen from previous reports in which process and mechanical details were jumbled together.

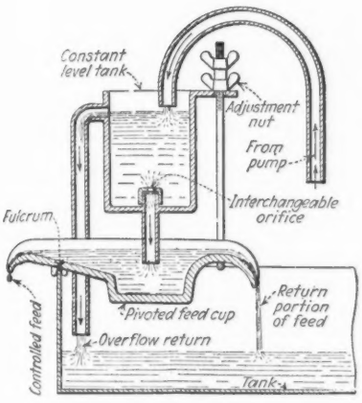
Approximately 40 per cent of the total contents is in Part III, on Physical Metallurgy. This was prepared by Dr. Doan. It is a valuable compilation and includes information with which the average metallurgist is none too familiar. Of necessity, it contains more technical and mathematical presentations of material than the rest of the book. However, it is excellently written and reads like a story. C. W. EICHRODT.

THE WITWATERSRAND GOLDFIELD. *By Dr. Han Sauer. Published by Walter E. Skinner, 15 Dowgate Hill, London, E. C. 4, England. Price 3s. 9d., net, post free abroad. Pp. 30. Two maps.*

This brochure is interesting principally for the two maps accompanying it, one a property map showing in a general way the approximate holdings of the principal mining companies on the Rand, with its newer extensions; the other a sketch map giving roughly the main features of the surface geology. These maps, however lacking in accurate detail, will at least enable the foreign reader of Rand news to orient himself and follow developments in the newer areas more intelligently. The text itself, though interesting, is so highly colored by Dr. Sauer's "unconscionable optimism" that an engineer will view it with distrust.

INDUSTRIAL PROGRESS





Liquid Reagent Feeder Now Patented

A United States patent for a liquid reagent feeder has been issued to H. G. Coulson, of Coulson Engineering Service, Wallace, Idaho. The device covered is said to be extensively used. An illustration shows the principle of operation. The feeder is made in several models, differing according to the kind and quantity of reagents to be fed. These models are either open or inclosed and vary as to the means used for raising the liquid to the constant-level tank, some being fitted with motor-driven pumps, others with air lifts, and still others with bucket wheels. Outstanding characteristics are said to be the constant feed and non-clogging feature, freedom from operating difficulties, and easy adjustment

For Pumping Acid

A centrifugal pump without a stuffing box, and which is used for pumping corrosive liquids, has been announced by A. R. Wilfley & Sons, Inc., Denver, Colo. It is known as the Model "AB" Unitary motor pump. Besides lacking a stuffing box, it has no rubbing contact between the stationary and rotating parts while running. It is a single-stage end-suction design with suction characteristics. Leakage is zero, whether the pump is running or shut down. With this design a closed impeller can be used, effecting a marked power saving, it is said. For handling acids, the pump is made in various industrial alloys.

New Vertical Compressors

In an effort to achieve lower compressed air costs, the Gardner-Denver Company has developed a new line of vertical compressors which deliver exactly the same amount of air as horizontals of the same capacity. Installation and maintenance costs are said to be much lower, and, in addition, the new unit takes considerably less floor space. The valves are cushioned, being silent in consequence. Extra-large water jackets are used to assure minimum cylinder temperatures. The air is cooled between stages by a water-cooled intercooler.

Placer Mining Machine

At Lewistown, Mont., Paul Baughman has developed a placer mining machine, consisting of a constant speed scrubber and screen, with a chute below leading to a variable-speed centrifugal concentrator, the whole being mounted on the chassis of an old motor car. Water is pumped into the hopper, which receives the ore from a 20-ft. belt and bucket conveyor, all driven by the car engine. Tests are said to show that this machine will recover fine flake gold.

New Electric Furnace

For high temperature or metallurgical work where an arc furnace smaller than 50-lb. size is desirable, the Pittsburgh Lectromelt Furnace Corporation, Pittsburgh, Pa., has introduced a new 25-lb. Lectromelt arc furnace operating with either direct, indirect, or submerged arcs. The furnace body may be removed from its stand and the melt poured off as from a shank ladle. Roof and electrode arms are arranged to facilitate quick charging. The furnace may be tapped, if desired. This unit is usually operated direct on 110 volts a.c. or with a transformer on 220, 440, or even higher voltage. It is said to have a wide range of application.

Diesel of Simple Design

A new four-cylinder diesel engine which develops 75 hp. at a rated speed of 1,200 r.p.m. and is exceedingly simple in design and operation has been introduced by the American Diesel Engine Co., Oakland, Calif. It has only one valve per cylinder, which permits use of the Monovalve design. Fuel consumption at 75 hp. is 0.44 lb. per hp.-hr. The engine can be run over a speed range of 200 to 2,000 r.p.m. and still give a clear exhaust and a fuel consumption of less than 0.5 lb. per hp.-hr. Expressed in terms of available horsepower, this means that the range is from 35 to 125 hp.

Improved Floodlights

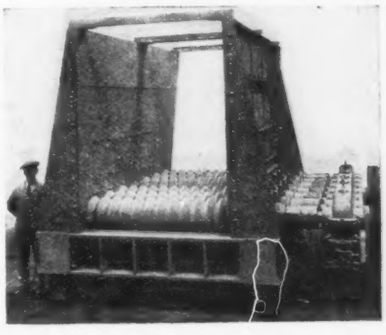
Several improvements in its line of so-called "Handy" floodlights have been announced by General Electric. In its Exposition model an adjustable socket support is now being furnished to accommodate both 500- and 1,000-watt general-service incandescent lamps. When the socket is fully in, the 1,000-watt lamp is in focus; when the socket is fully out, the 500-watt lamp is in focus. A 1,500-watt hard-glass lamp can be used with the projector, if the lens is removed. Other changes include a slightly increased gage of the aluminum casing and the use of a substantial hexagonal nut to give positive clamping to the standard mounting.

Motor-Centrifugal Pump

Compactness, high efficiency, and low cost are said to have been combined in a motor-centrifugal pumping unit announced by Goulds Pumps, Inc., Seneca Falls, N. Y. A new close-coupled type of mounting is employed, which permits use of standard motors without special bedplates and brackets. The bedplate extends under the motor, relieving it of excessive strains. The pump is built in sizes $\frac{3}{4}$ in. to 4 in., for capacities up to 1,000 g.p.m. Heads range from 10 to 290 ft. The applications of these new pumps to the mining field are many and varied.

Live Roller Grizzly

An adjoining cut shows a typical live roller grizzly made by Hadfields, Ltd., Sheffield, England, for large crushing plants. It is built in various sizes and in slightly different forms to suit volume and character of rock. The one shown has seven rollers, 15 in. in diameter by 67 in. long between side frames. Each roller is built up of double cone-shaped manganese-steel disks, threaded and secured on an 8-in. forged-steel shaft and prevented by a feather key



from turning. To ensure a perfect fit, these are ground flat where they butt up to each other, and when fitted on the shaft are tightly pressed together and held by a cotter pin. The roller shafts have 6½-in. journals and run in heavy bearings. Power is transmitted to them by a gear train. Each succeeding roller, starting from the feed end, revolves at an increased speed. This action, besides screening out all undersize, regulates the flow of the aggregate over the grizzly, and thereby maintains a uniform rate of feed to the crusher. Owing to the varying speed, relatively, of the rollers, material can hardly become wedged between them, as the motion tends to keep them free from obstruction.

Unique Control for Scraper in Stripping Work

A unique form of hydraulic control which is claimed to be an improvement over previous schemes for hydraulic operation of a scraper with a tractor is featured in the Crescent hydraulic scrapers introduced by Sauerman Bros., Inc. In particular, it is said to increase greatly the scraper's effectiveness in penetrating hard earth materials. The hydraulic control provides a crowding action for digging, besides the usual dumping and holding operations of the normal hydraulic scraper. This action requires a double-acting ram and a control valve with a single operating lever having five positions instead of the usual three provided on the ordinary double-acting valve. Not being able to find a hydraulic valve on the market having these five operating positions, the company's engineers designed a suitable one.

Strain Insulator Fittings

To develop the full strength of porcelain strain insulators, Ohio Brass Company has designed a new line of fittings which will accommodate all of the various sizes and makes of standard strain insulators. The new fittings consist of a yoke and a length of stranded cable, each end of which is flash-welded to a turned ball-terminal. Due to the fact that the strand conforms perfectly to the contour of the insulator, it is possible to develop the full strength of the porcelain. The yoke has two sockets, into which the terminals fit.

Corrosion-Resisting Pump

A new centrifugal pump for handling corrosive chemicals has been developed recently by the Duriron Company, Dayton, Ohio. It has a 1-in. suction, 1-in. discharge, and, at 1,750 r.p.m., its capacity ranges from 2½ g.p.m. at 25-ft. head to 25 g.p.m. at 5-ft. head, with power requirements varying from approximately ¼ hp. to less than ½ hp., these figures being based on water. One of these pumps, made of Durichlor, a new alloy almost entirely resistant to hydrochloric acid in all concentrations and temperatures up to boiling, is being used to pump 25 g.p.m. of 15 per cent hydrochloric acid containing uranium, lead, and ferric chloride in extracting radium in Canada. The same type pump may also be had in Duriron, for general acid service, and in other alloys.

Industrial Notes

General Electric Co. was presented on Feb. 1 with the gold medal of the American Institute of the City of New York "for pioneering in industrial research." In reviving its old custom of recognizing achievements in science which have profoundly influenced human affairs, the Institute's Council on Awards decided that the establishment and maintenance by the General Electric Co. of its laboratory for pure science research has had a broad incidence on human welfare. This is the first award ever received by the General Electric Co. as a corporation.

Sullivan Machinery Co. is sole representative for Nordberg Manufacturing Co. for the sale of Symons cone crushers and parts in Mexico. Sullivan offices covering this territory are: Edificio Cook, Dept. 1, Mexico, D.F.; 121 North Kansas St., El Paso, and 582 Market St., San Francisco.

SKF Industries, Inc., have moved from New York to Front St. and Erie Ave., Philadelphia, Pa.

Ambler Asbestos Shingle & Sheathing Co. has been merged with Keasby & Mattison Co., both of Ambler, Pa. Controlling interest in the latter has been acquired by Turner & Newall, Ltd., of Great Britain. The merged business will retain the name of Keasby & Mattison Co. American capital will continue to be represented and the company will remain under American management, according to A. S. Blagden, who will continue as president of the American company.

Leo W. Grothaus, of Milwaukee, and Robert M. Gaylord, of Rockford, have been elected to the executive committee of the Machinery and Allied Products Institute. Mr. Grothaus is an officer of the Allis-Chalmers Manufacturing Co. and Mr. Gaylord is president of the Ingersoll Milling Machinery Co. The former will represent the Rock and Ore Crusher Association in the M.A.P.I. councils.

A. C. Daman, president of Denver Equipment Company, recently returned from London, where he formed a subsidiary, to be known as the Denver Equipment Company, Ltd. E. A. Knapp and W. R. Bates will be in charge. The new company will handle business in Europe and Africa.

T. Shriver & Company, Harrison, N. J., manufacturer of filter presses, has appointed the Merrill Company, San Francisco, Calif., as sales representatives in the Rocky Mountain and Pacific Coast areas.

Bulletins

Mill Sampling. General Engineering Co., Salt Lake City, Utah. Bulletin 3302. Gecoelectric sampler No. 3. Pp. 12.

Filter Presses. T. Shriver & Co., Harrison, N. J. Catalog. Pp. 52.

Stone Crushing. Hadfields Limited, Sheffield, England. Catalog 360. Portable stone-breaking plants. Pp. 12.

Nickel and Its Alloys. International Nickel Co., New York. Information bulletin on castings. Pp. 30.

Abrasion-Resisting Cast Iron. Robins Conveying Belt Co., New York. Bulletin 87, Super Manga iron. Pp. 4.

Cement Gun. Cement Gun Co., Allentown, Pa. Bulletin 200. Pp. 50.

Screen Pulverizers. Raymond Bros. Impact Pulverizer Co., Chicago. Bulletin on screen mills. Pp. 8.

Pumps. Roots-Connersville-Wilbraham, Connersville, Ind. Bulletin on regenerative turbine pumps. Pp. 4.

Compressors. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin 612-B1A. Feather-valve compressors. Pp. 27.

Concentration. Cottrell Engineering Co., Los Angeles, Calif. Bulletins on high-speed dry concentrator and wet concentrators, respectively. Pp. 2 each.

Lighting. Solite Sales Corp., 1373 Sixth Ave., New York. Leaflet on floodlights designed for wide applicability and which can be focussed at any angle. Pp. 4.

Classification. Hardinge Company, York, Pa. Bulletin 39. Hardinge counter-current classifier. Pp. 8.

Self-Locking Screw Thread. Dardelet Threadlock Corporation, New York. Dardelet Thread Handbook for engineers, designer, and mechanics. Pp. 220. Price $2.

Ore Dressing. The Dorr Co., New York. Bulletin 2231. Classification and Ore Dressing. Pp. 20.

Vibrating Screens. Jeffrey Manufacturing Co., Jeffrey-Traylor Division, Columbus, Ohio. Bulletin 579, "Electric Vibrating Screens." Pp. 12. Also Bulletin 582, "Electric Vibrating Feeders"; Bulletin 581, "Electric Vibrating Conveyors"; and Bulletin 583, "Electric Vibrating Cooler-Dryers."

Hard Facing. Haynes Stellite Co., New York. Bulletin. "Hard Facing With Haynes Stellite Products." Pp. 95.

Vibrating Screens. Productive Equipment Corporation, Chicago, Bulletin 732. The Jigger vibrating screen. Pp. 20.

Drill Steel Furnaces. Sullivan Machinery Co., New York. Oil-fired furnaces. Pp. 8.

Plant Hoists. The Harnischfeger Corp., Milwaukee, Wis. Bulletin RH-1.

Sand Pump. Allen-Sherman-Hoff Co., Philadelphia, Pa. Bulletin 134, Hydroseal sand pump. Pp. 8.

Daily and Average Monthly Prices of Metals

January, 1934

United States Market

Jan.	Electrolytic Copper Domestic	Electrolytic Copper Export	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1			Holiday			
2	8.025	8.050	53.200	4.00	3.90	4.30@4.35
3	8.025	7.950	53.000	4.00	3.90	4.30
4	8.025	7.825	52.650	4.00	3.90	4.30
5	7.775	7.825	52.500	4.00	3.90	4.30
6	7.775	7.825	52.375	4.00	3.90	4.25
8	7.775	7.650	52.000	4.00	3.90	4.25
9	7.775	7.650	52.000	4.00	3.90	4.25
10	7.775	7.550	52.000	4.00	3.90	4.25
11	7.525@7.775	7.725	52.300	4.00	3.90	4.25@4.275
12	7.525@7.775	7.675	52.000	4.00	3.90	4.25
13	7.775	7.700	52.000	4.00	3.90	4.25
15	7.775	7.775	53.000	4.00	3.90	4.25
16	7.775	7.800	52.500	4.00	3.90	4.25
17	7.775	7.750	52.000	4.00	3.90	4.25@4.30
18	8.025	7.700	51.350	4.00	3.90	4.30
19	8.025@8.150	7.900	52.000	4.00	3.90	4.30
20	8.025@8.275	7.975	51.875	4.00	3.90	4.30
22	8.025@8.150	7.950	51.575	4.00	3.90	4.25@4.30
23	8.025@8.150	7.950	51.530	4.00	3.90	4.25
24	8.025	7.950	51.375	4.00	3.90	4.25
25	8.025	7.925	51.000	4.00	3.90	4.25
26	7.900@8.025	7.875	50.600	4.00	3.90	4.25
27	7.900	7.850	51.000	4.00	3.90	4.25
29	7.900	7.900	51.000	4.00	3.90	4.25
30	7.775	7.975	51.375	4.00	3.90	4.30
31	7.775	7.900	50.950	4.00	3.90	4.30
Av. for month	7.890	7.831	51.891	4.00	3.90	4.271
			Averages for Week			
3	8.025	7.965	52.860	4.09	3.99	4.335
10	7.817	7.721	52.254	4.00	3.90	4.267
17	7.733	7.738	52.300	4.00	3.90	4.256
24	8.077	7.904	51.618	4.00	3.90	4.279
31	7.890	7.904	50.988	4.00	3.90	4.267
			Calendar Week Averages			
6	7.925	7.895	52.745	4.00	3.90	4.295
13	7.733	7.658	52.050	4.00	3.90	4.252
20	7.931	7.817	52.121	4.00	3.90	4.279
27	8.015	7.917	51.180	4.00	3.90	4.254

Silver, Gold, and Sterling Exchange New York and London

Jan.	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (a) New York	Silver London	Gold London	Gold (b) United States
1			Holiday			
2	5.1400	5.1850	44.8750	19.3125	127s	$34.06
3	5.1525	5.2025	44.7500	19.3125	127s 6 d	34.06
4	5.1200	5.1700	43.8750	19.1250	127s 6 d	34.06
5	5.1150	5.1600	44.2500	19.1250	127s 6 d	34.06
6	5.1150	5.1650	44.0000	19.1250	126s 11 d	34.06
8	5.0775	5.1275	43.8750	19.1250	126s 8 d	34.06
9	5.0825	5.1375	43.7500	19.0625	126s 8½d	34.06
10	5.0850	5.1300	43.7500	19.1250	127s 1 d	34.06
11	5.0850	5.1300	44.0000	19.1875	127s 1 d	34.06
12	5.0775	5.1075	44.3750	19.3125	127s 2 d	34.06
13	5.0900	5.1300	44.6250	19.4375	127s 11 d	34.06
15	5.1200	5.1400	45.0000	19.6875	128s 6 d	34.06
16	5.0775	5.1075	44.6250	19.5000	131s 9 d	34.45
17	5.0650	5.0900	44.6250	19.5000	131s 6 d	34.45
18	4.9600	4.9900	44.3750	19.5625	132s 10 d	34.45
19	5.0200	5.0425	44.5000	19.7500	132s 10 d	34.45
20	4.9925	5.0150	44.3750	19.6250	132s 9 d	34.45
22	5.0050	5.0275	44.3750	19.6250	132s 11 d	34.45
23	5.0050	5.0250	44.2500	19.5000	132s 9 d	34.45
24	4.9900	5.0100	44.2500	19.4375	132s 10 d	34.45
25	4.9700	4.9950	43.3750	19.2500	132s 1 d	34.45
26	4.9350	4.9600	43.2500	19.3125	132s 8 d	34.45
27	4.9650	4.9950	43.3750	19.3125	132s 3 d	34.45
29	4.9775	5.0075	44.0000	19.5625	132s 5½d	34.45
30	5.0150	5.0400	44.3750	19.5625	132s 10 d	34.45
31	4.9700	5.0000	44.0000	19.5000	133s 1 d	34.45
Av. for month	5.04644	.....	44.188	19.382	.....	34.27
			Averages for Week			
3	5.12250	.....	44.600	.....	.....	.....
10	5.09917	.....	43.917	.....	.....	.....
17	5.08583	.....	44.542	.....	.....	.....
24	4.99542	.....	44.354	.....	.....	.....
31	4.97208	.....	43.729	.....	.....	.....

Calendar week averages: New York Silver Jan. 6, 44.350; Jan. 13, 44.063; Jan. 20, 44.583; Jan. 27, 43.813.

(*a*) Silver not eligible for sale to U. S. Government.

(*b*) Gold prices for the period beginning Jan. 1 and ending Jan. 15, inclusive, were posted by the Reconstruction Finance Corporation. Beginning with Jan. 16 the price was announced by the U. S. Treasury.

London Market

Jan.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1.....					Holiday				
2.....	32.1875	32.3125	35.5000	227.1250	227.5000	11.0625	11.3750	14.6250	14.9375
3.....	32.1250	32.2500	35.5000	226.8750	227.1250	10.8750	11.1250	14.3750	14.7500
4.....	32.0625	32.2500	35.2500	224.8750	225.3750	11.0000	11.3125	14.4375	14.8125
5.....	31.8125	32.0000	35.2500	226.1250	226.3750	10.8750	11.1875	14.4375	14.8125
8.....	31.5625	31.7500	34.7500	224.6250	225.0000	10.6875	11.0625	14.1875	14.5625
9.....	31.3125	31.4375	34.7500	224.2500	224.3750	10.8750	11.1875	14.1875	14.5625
10.....	31.2500	31.3750	34.2500	224.3750	224.6250	10.9375	11.2500	14.3125	14.5625
11.....	32.0000	32.1250	35.0000	226.7500	227.2500	11.2500	11.5000	14.6875	15.0000
12.....	31.7500	31.8750	35.0000	227.0000	227.3750	11.0625	11.3125	14.5000	14.8125
15.....	32.0625	32.1875	35.0000	227.2500	227.6250	11.1875	11.3750	14.6250	14.8750
16.....	32.1875	32.3125	35.2500	227.7500	228.1250	11.3125	11.5625	14.6250	14.9375
17.....	32.1875	32.3125	35.2500	227.5000	227.6250	11.4375	11.6250	14.7500	15.0000
18.....	32.9375	33.0625	36.0000	228.1250	228.1250	11.8125	12.0000	15.1250	15.3750
19.....	33.2500	33.3750	36.5000	228.1250	227.8750	11.6875	11.8750	15.1250	15.2500
22.....	33.2500	33.4375	36.0000	227.7500	227.5000	11.6875	11.8750	15.0000	15.1875
23.....	32.9375	33.1250	36.0000	227.6250	227.2500	11.6250	11.7500	14.8750	15.0625
24.....	33.8125	33.9375	37.0000	227.5000	227.3750	11.7500	11.8750	15.0000	15.1875
25.....	33.4375	33.5000	36.0000	226.5000	226.3750	11.6250	11.6875	14.9375	15.1250
26.....	33.1875	33.3125	36.0000	226.6250	226.5000	11.5625	11.6875	14.8125	15.0000
29.....	33.7500	33.9375	36.2500	226.2500	226.1250	11.5625	11.6875	14.8125	14.9375
30.....	33.6875	33.8750	36.5000	226.6250	226.3750	11.5000	11.6250	14.8750	15.1250
31.....	33.5625	33.6875	36.5000	226.2500	225.7500	11.3125	11.4375	14.8125	14.9375
Av. for month.	32.560	.....	35.614	226.631	.....	11.304	11.517	14.688	14.946

The United States quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices of domestic class are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted as 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West usually command a pre-

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1933	1934	1933	1934	1933	1934
January	25.400	44.188	16.883	19.382	336.060	504.644
February	26.074		16.885		342.114	
March	27.928		17.588		343.138	
April	30.730		18.440		357.565	
May	34.072		19.046		393.106	
June	35.663		19.078		413.216	
July	37.630		18.341		464.760	
August	36.074		17.877		449.944	
September	38.440		18.272		466.240	
October	38.190		18.221		466.380	
November	42.974		18.428		514.573	
December	43.550		18.674		511.260	
Year	34.727		18.144		421.530	

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Zinc

	St. Louis		London			
	1933	1934	1933	1933	1934	1934
			Spot	3 Mos.	Spot	3 Mos.
January	3.018	4.271	14.381	14.595	14.688	14.946
February	2.666		13.866	14.119		
March	2.987		14.647	14.674		
April	3.298		14.951	15.208		
May	3.805		15.505	15.660		
June	4.348		16.988	16.774		
July	4.878		17.795	17.789		
August	4.916		16.869	17.031		
September	4.699		16.810	17.042		
October	4.748		16.310	16.599		
November	4.520		15.048	15.349		
December	4.461		14.826	15.059		
Year	4.029		15.666	15.825		

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Copper

	F.O.B. Refinery			London Spot			
	Electrolytic			Standard		Electrolytic	
	Domestic		Export				
	1933	1934	1934	1933	1934	1933	1934
January	4.775	7.890	7.831	28.557	32.560	33.244	35.614
February	4.775			28.481		32.556	
March	5.011			28.179		32.370	
April	5.395			29.576		33.681	
May	6.698			34.071		38.163	
June	7.773			36.759		41.000	
July	8.635			37.917		41.524	
August	8.768			36.071		40.227	
September	8.753			35.122		38.339	
October	7.950			33.656		36.977	
November	7.881			30.588		33.898	
December	7.885			31.306		34.329	
Year	7.025			32.524		36.359	

New York quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1933	1934	1933	1934
January	55.000	55.000	23.300	23.300
February	55.000		23.300	
March	55.000		23.300	
April	55.000		23.300	
May	55.000		23.300	
June	55.000		23.300	
July	55.000		23.300	
August	55.000		23.300	
September	55.000		23.300	
October	55.000		23.300	
November	55.000		23.300	
December	55.000		23.300	
Year	55.000		23.300	

Aluminum in cents per pound, 99 per cent grade.
Cadmium, cents per pound.

Lead

	New York		St. Louis		London			
	1933	1934	1933	1934	1933	1933	1934	1934
					Spot	3 Mos.	Spot	3 Mos.
January	3.000	4.000	2.875	3.900	10.458	10.833	11.304	11.517
February	3.000		2.875		10.431	10.719		
March	3.146		3.021		10.609	10.821		
April	3.260		3.135		10.872	11.122		
May	3.654		3.525		12.095	12.372		
June	4.173		4.023		13.280	13.571		
July	4.452		4.303		13.411	13.613		
August	4.500		4.350		12.182	12.457		
September	4.500		4.350		11.932	12.229		
October	4.313		4.176		11.804	12.102		
November	4.288		4.146		11.537	11.778		
December	4.141		4.042		11.431	11.658		
Year	3.869		3.735		11.670	11.940		

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1933	1934	1933	1934	1933	1934
January	5.722	7.198	48.500	67.538	26.480	38.000
February	5.738		48.614		24.000	
March	5.901		52.676		24.667	
April	5.876		54.580		26.800	
May	6.264		56.500		28.500	
June	6.500		60.038		30.000	
July	7.262		62.900		32.320	
August	6.986		63.500		33.000	
September	6.880		64.580		34.560	
October	6.843		66.500		36.000	
November	7.113		66.000		37.583	
December	7.250		66.330		38.000	
Year	6.528		59.227		30.993	

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Tin

	New York		London	
	1933	1934	1933	1934
	Straits		Standard, Spot	
January	22.692	51.891	145.708	226.631
February	23.500		148.544	
March	24.221		149.120	
April	27.136		157.944	
May	36.051		186.207	
June	44.097		219.964	
July	46.356		216.673	
August	44.794		215.210	
September	46.665		216.893	
October	47.858		223.455	
November	53.011		226.722	
December	52.936		227.678	
Year	39.110		194.510	

New York quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1933	1934	1933	1934	1933	1934
January	14.50	18.00	14.00	17.00	14.50	17.50
February	14.50		14.00		14.50	
March	14.50		14.00		14.50	
April	14.50		14.00		14.50	
May	15.42		14.42		14.92	
June	16.00		15.00		15.50	
July	16.50		15.50		16.00	
August	17.00		16.00		16.50	
September	18.00		17.00		17.50	
October	18.00		17.00		17.50	
November	18.00		17.00		17.50	
December	18.00		17.00		17.50	
Year	16.24		15.41		15.91	

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces

mium of 1c. over Prime Western zinc.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

New York silver quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, 925 fine. Sterling prices represent noon market demand.